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THE CONDOR

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VOLUME 55

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1953

COLLARED MICRASTUR

MICRASTUR SEMITORQUATUS

Two-fifths natural size

Painting by Andrew Jackson Grayson

THE CONDOR

VOLUME 55 JANUARY-FEBRUARY, 1933 NUMBER 1

CYCLIC CHANGES IN LIVER AND SPLEEN WEIGHTS IN MIGRATORY WHITE-CROWNED SPARROWS

By BARBARA BLANCHARD OAKESON

This paper reports part of a study of physiologic changes paralleling the reproductive cycle in a migratory race of the White-crowned Sparrow (*Zonotrichia leucophrys*). The cycle in the testis and concomitant changes in body weight, subcutaneous fat, and molt have been worked out for *Zonotrichia leucophrys gambelii* on its wintering grounds at Davis and Santa Barbara, California (Blanchard and Erickson, 1949), and for *Z. l. pugetensis* on both wintering and breeding grounds (Blanchard, 1941). It is proposed now to probe deeper into the question of metabolic changes, to learn something of their direction and magnitude and, if possible, of the endocrine mechanisms involved.

Analysis of seasonal changes in liver weight constituted the first point of attack, since they can be recorded without complicated apparatus and are likely to reflect more deep-seated endocrine changes hard to detect in wild animals in the field. Spleen weights were also recorded to check whether or not changes paralleling those in the liver, such as Riddle (1928) found in Ring Doves, occur in the White-crowned Sparrow.

Although liver and spleen weights have been analyzed for a number of captive species (for example Riddle, 1928 and 1929; Kirkpatrick, 1944), few data are available for wild birds in their native environments. In this connection, the material obtained from Mountain Village, Alaska, while disappointingly meager owing to the need to save most of the sparse breeding population there for behavior studies, is especially valuable.

ACKNOWLEDGEMENTS

Research for this paper was carried on under the Fellowship Crusade National Fellowship, awarded for 1949-1950 by the American Association of University Women, to whom my thanks are due. The field work at Santa Barbara was aided by two grants from the Committee on Research at Santa Barbara College.

I wish to thank Dr. Laurence Irving, Chief, Physiology Section, United States Public Health Service at Anchorage, Alaska, for his help and encouragement in planning the field work in Alaska. His support of the project made possible the invaluable assistance of the Public Health Service, for which I acted as consultant. I am indebted to Dr. Jack C. Halderman, Medical Officer in Charge of the Public Health Laboratory at Anchorage, who arranged for my transportation in Alaska, loaned me equipment to take into the field, and placed at my disposal the laboratory and library facilities of the Anchorage Laboratory.

I wish to express my appreciation to Mr. Henry C. Kyllingstad for allowing me to draw upon his banding records and observations of White-crowned Sparrows in Alaska, and to Mr. and Mrs. George Sheppard, of Mountain Village, Alaska, for extending to me the hospitality of their home.

I am indebted to my husband, Nels Oakeson, for drawing the graphs and helping

with the calculations for the tables, and to Dr. Mary M. Erickson, for help in collecting material at Santa Barbara and for criticism of the manuscript.

MATERIAL AND METHODS

One hundred and ninety-one specimens of *Z. l. gambelii* were taken at approximately two-week intervals from late September through April at Santa Barbara, California (lat. 34°30′N.). The material for January through April was collected in three successive years (1949-1951), that for September through December, in 1949 alone. Seventeen birds were collected from May through July, 1950, at Mountain Village, Alaska (lat. 62°07′N.). No material is available for August.

All birds from Santa Barbara were trapped at dawn at points where the flocks went to feed immediately upon leaving their roosts. Except for a few seeds of bait, therefore, the birds had eaten nothing since the evening before. Two to fifteen minutes after they were trapped the birds were killed, put on ice, and taken to the laboratory for dissection. Body weight, amount of fat, diameters of testis or of ovarian follicles, and stage of molt were recorded. Between one-half and two hours after death, the liver, without gallbladder, and spleen were weighed fresh, on a Roller-Smith precision balance. The gonads and other endocrine glands were fixed in Bouin's and prepared for histological examination.

At Mountain Village most of the birds were shot, since it was imperative in May to get new arrivals, and trapping would have involved several days' delay for the birds to discover the bait. Specimens were cooled en route back to headquarters by the icy wind, which blew almost continuously. Data identical with those for the Santa Barbara birds were recorded, and the time elapsing between death and weighing averaged about the same. The livers and spleens were weighed on a pan balance accurate to one milligram.

Measurements of structures least subject to seasonal wear, that is, tarsus, middle toe and beak, were made to check whether the Santa Barbara birds differed significantly from those at Mountain Village in mean values for body dimensions.

In the statistical analysis, the formula used for comparison of means of two samples is that given by Simpson and Roe (1939:193):

$$\sigma_d = \sqrt{\frac{\Sigma(d_1^2) + \Sigma(d_2^2)}{N_1 N_2}}$$

In April, birds which had wintered on the spot were distinguished by banding and observation from those already in migration from more southern wintering grounds. About one-fourth of the birds taken at Santa Barbara in April had been banded there in winter by Dr. Mary M. Erickson. The unbanded birds in the same flocks with and trapped at the same time as the banded individuals had undoubtedly also wintered on the spot. In addition, many banded birds were retrapped in April, released and watched, to determine the dates of departure. Individuals taken after all banded birds had disappeared from the trapping grounds were presumed to be migrants from more southern wintering grounds. Three males and two females included in the "fat and very fat" April birds in tables 2 and 3 are in this category. In tables 4 and 5 they are grouped separately.

Observation and banding were also used to identify the Mountain Village specimens as members of the local breeding population. The first birds to reach Mountain Village in May, 1950, began at once to establish territories. Those collected were, up to the moment of death, behaving like others color-banded and subsequently followed throughout the nesting season. One male had been hatched nearby two years before. In July,

1948, it had been banded as a juvenile by Mr. H. C. Kyllingstad about a mile from where I collected it in 1950.

From September through early April immature White-crowned Sparrows can be distinguished by their brown heads, and are shown in the figures by hollow dots. Freshly-molted birds taken in mid-April may include some which had not bred, since the immatures have by then acquired adult plumage. The present material gives no hint of consistent differences between organ weights of adults and those of immatures. The latter are omitted from all but the first table, since their numbers are too small to provide statistically significant data.

RESULTS

Although the ensuing discussion involves comparison of wintering Santa Barbara birds with those breeding at Mountain Village, no identity of population is implied. There is little chance that a White-crowned Sparrow of the race *gambelii* banded in winter will ever be found on its breeding grounds, although this actually happened in the case of two individuals of the related race, *Z. l. pugetensis* (Clabaugh, 1929; Abbott, personal communication). Failing this piece of luck, we shall never know precisely where members of a given winter flock of *gambelii* go to nest. By analogy with *pugetensis*, however (Blanchard, 1942), there is reason to think that Gambel Sparrows flocking within a few hundred miles of the southern extreme of the wintering range come from far northern breeding grounds and therefore that both at Santa Barbara and Mountain Village we are dealing with strongly migratory populations, which may nest in latitudes not far apart. It is at least a cogent possibility that our necessarily composite data approximate the cycle in individual sparrows of far northern breeding populations.

LIVER WEIGHTS

Males.—The results are graphed in figures 1-3 and are summarized in tables 1, 2, 4, 6 and 7. In tables 1 and 2 monthly means are given. In table 4 the data are grouped into periods according with the broad divisions of the annual cycle.

Figure 3 shows a rise in mean values of absolute liver weights in adult males from November, 1949, through April, 1950. With the exception of February, this is also true if material for three seasons is included in the monthly averages for January through April (table 2). Table 4 shows a consistent rise for successive periods (I through IV) of the annual cycle. Table 6 shows that the increase of liver weights of fat April males, on the verge of migration, over November males is 30.0 per cent. A still higher figure is obtained if October is used as the starting point, but migration is still in progress in early October, and some of the birds collected then may not have belonged to the local wintering population.

Between the time just before departure from Santa Barbara and that when males arrived on their breeding grounds at Mountain Village, a period of about six weeks in 1950, the liver weights show a sharp drop (figs. 1 and 3, and tables 2 and 4). If the mean value for all April males with adult plumage is compared with that for males taken in Mountain Village in May, 1950 (table 2), the percentage drop is 29.4. The value for 1950 alone is comparable: from the mean for April (1089.0 mgm.) to that for May (775.4 mgm.), the percentage drop is 28.8. Table 6 shows a still greater decrease from the fat and very fat April birds wintering at Santa Barbara to the birds collected in May at Mountain Village (30.7 per cent). This figure nearly balances the 30.0 per cent increase from November to April.

Table 7 shows that the differences between the means for November and the spring months, and for April and May, are highly significant. (The method used is reliable only if $N_1 + N_2 = 25$ or more, so the pairs of months or periods with joint totals less

Table 1

Monthly Means of Body, Liver and Spleen Weights

MALES

Month	Number All	Number Ad.	Number Im.	Mean total body weight (gm.) All birds	Mean total body weight (gm.) Adults	Mean total body weight (gm.) Immatures	Mean liver weight (mgm.) All birds	Mean liver weight (mgm.) Adults	Mean liver weight (mgm.) Immatures	Mean spleen weight (mgm.) All birds	Mean spleen weight (mgm.) Adults	Mean spleen weight (mgm.) Immatures
Sept.	1	1	....	26.3	26.3	.....	769	769	.....	50	50	.....
Oct.	11	9	2	26.28	26.50	25.30	842.1	842.0	842.5	33.1	33.7	30.5
Nov.	12	10	2	25.80	26.03	24.65	866.3	850.6	945.0	33.7	35.8	24.5
Dec.	5	5	....	26.46	26.46	.....	915.2	915.2	.....	50.4	50.4	.....
Jan.	29	18	11	26.67	27.02	26.11	990.0	984.8	998.6	46.3	41.4	55.2
Feb.	9	7	2	26.29	25.97	27.40	917.4	890.7	1011.0	37.8	35.0	47.5
Mar.	33	21	12	27.29	27.32	27.24	1025.5	1043.1	994.8	46.8	46.8	46.9
Apr.	35	32	3	28.31	28.42	27.17	1084.3	1097.8	940.3	40.1	39.2	50.0
May	8	8	....	25.94	25.94	.....	775.4	775.4	.....	19.6	19.6	.....
June	1	1	....	28.9	28.9	.....	951	951	.....	17	17	.....
July	2	2	....	26.00	26.00	.....	847.5	847.5	.....	28.5	28.5	.....
Total	146	114	32									

FEMALES

Sept.	1	1	....	23.6	23.6	.....	850	850	.....	56	56	.....
Oct.	3	3	....	24.27	24.27	.....	799.7	799.7	.....	30.3	30.3	.....
Nov.	5	3	2	24.44	24.47	24.40	853.0	886.0	803.5	32.8	27.7	40.5
Dec.	2	1	1	21.60	21.7	21.5	736.0	666	806	25.0	19	31
Jan.	6	5	1	23.67	23.82	22.9	832.7	862.0	686	31.4	24.5	59
Feb.	3	1	2	23.20	23.8	22.90	800.3	830	785.5	38.7	38	39.0
Mar.	10	9	1	24.80	24.93	23.6	946.0	957.7	841	37.9	32.8	79
Apr.	26	25	1	26.08	26.08	26.0	1041.5	1039.0	1106	34.9	34.6	42
May	3	3	....	25.50	25.50	.....	979.7	979.7	.....	32.3	32.3	.....
June	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
July	2	2	....	22.90	22.90	.....	827.5	827.5	.....	24.0	24.0	.....
Total	61	53	8									

than 25 are omitted). The variation between the mean values for livers of adult November and March birds, for example, cannot be due to accidents of sampling, since the difference divided by its standard error is greater than 3: $\frac{d}{\sigma_d} = 4.13$). The difference between means for November and April is of course even greater and the significance still higher $\frac{d}{\sigma_d} = 4.63$). The most significant difference is that between the mean for all April birds and that for the Mountain Village birds collected in May: $\frac{d}{\sigma_d} = 5.35$).

What is important from the point of view of possible metabolic reserves for migration is that the ratios of liver to total body weight show seasonal variations parallel

Table 2

Monthly Means of Liver Weights (in mgm.) of Adults for All Years

Month	No.	Extremes	Mean	σ_m	σ	$\sigma\sigma$	Ratio, liver to body weight
MALES							
September	1	.....	(769)	.....	.....	.....	2.92
October	9	653–1010	842.0	40.2	120.6	28.4	3.18
November	10	675– 993	850.6	30.8	97.4	21.8	3.27
December	5	744–1112	915.2	63.8	142.3	45.0	3.46
January	18	805–1254	984.8	30.3	128.5	21.4	3.64
February	7	761–1006	890.7	30.3	80.4	21.5	3.42
March	21	739–1238	1043.1	28.7	131.6	20.3	3.82
April							
(a) all birds	32	843–1403	1097.8	28.3	159.9	20.0	3.86
(b) no, little, and moderately fat	20	859–1355	1067.2	31.1	139.2	22.0	3.91
(c) fat, and very fat	12	843–1403	1148.9	51.4	178.0	36.5	3.79
May	8	666–1058	775.4	42.2	118.9	29.7	2.99
June	1	.....	(951)	.....	.....	.....	3.29
July	2	820– 875	847.5	19.4	27.5	13.8	3.26
Total	114						
FEMALES							
September	1	.....	(850)	.....	.....	.....	3.60
October	3	782– 818	799.7	8.5	14.7	6.0	3.30
November	3	778– 956	886.0	44.7	77.5	31.8	3.62
December	1	.....	(666)	.....	.....	.....	3.07
January	5	741–1050	862.0	51.5	114.9	36.4	3.62
February	1	.....	(830)	.....	.....	.....	3.49
March	9	630–1309	957.7	70.3	210.8	49.7	3.84
April							
(a) all birds	25	749–1340	1039.0	32.0	159.7	22.6	3.98
(b) no, little, and moderately fat	16	749–1340	996.4	35.8	143.1	25.3	3.95
(c) fat, and very fat	9	819–1320	1114.7	53.1	159.4	37.6	4.04
May	3	867–1177	979.7	80.9	140.0	57.4	3.84
June	---	.....	.....	.....	.....	.....	.....
July	2	767– 888	827.5	43.2	60.5	30.3	3.61
Total	53						

with those already described, that is, the highest and lowest mean values for this ratio coincide with the beginning and end of migration, respectively (figs. 1 and 3 and table 2). The mean value for all April birds with adult plumage (3.86), for example, is higher than that for January adults (3.64) and for November adults (3.27) despite the fact

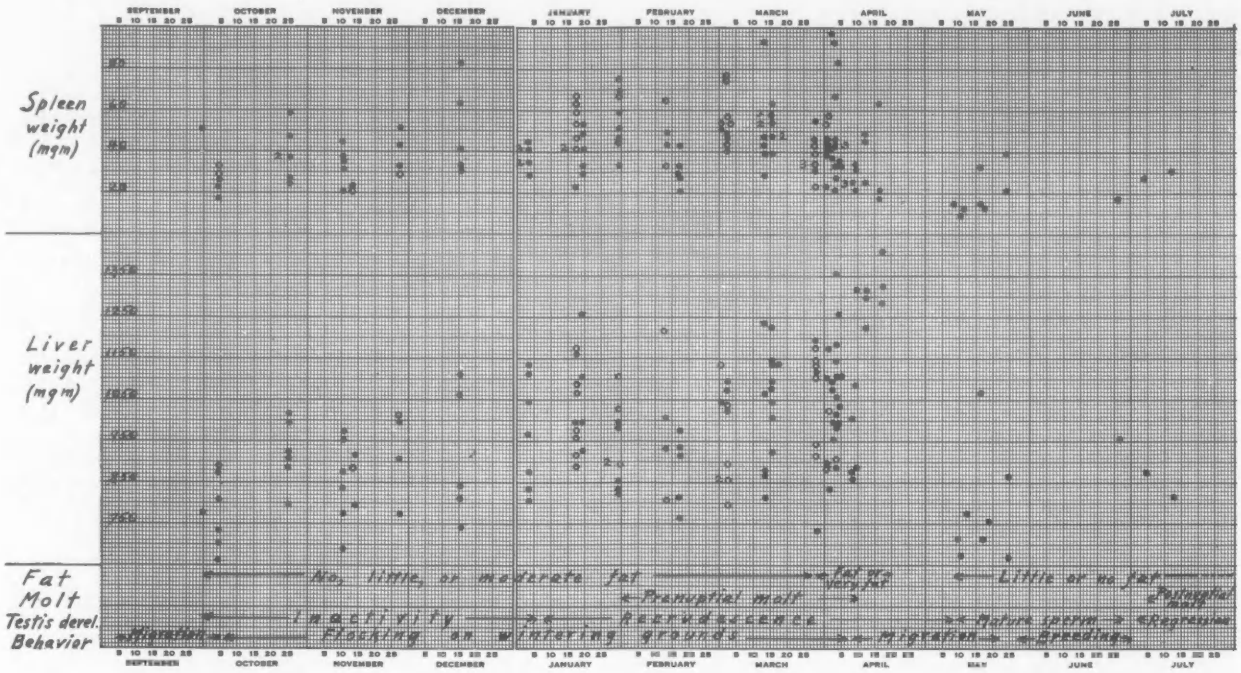

Fig. 1. Liver and spleen weights in relation to other elements of the annual cycle in males of *Zonotrichia leucophrys gambeli*. Solid dots, adults; circles, immatures. September-April, specimens taken at Santa Barbara. May-July, specimens taken at Mountain Villege, Alaska.

that the April value includes 12 fat and vary fat birds whose mean body weight (30.30 gm.) is 10.8 per cent higher than that of the birds taken in January and 14.0 per cent higher than that of the adults collected in November. If the ratio of liver to body weight for only those April birds with no, little, or moderate amounts of fat is used (3.91), the contrasts with November and January are more marked.

Table 3

Monthly Means of Spleen Weights (in mgm.) of Adults for All Years

Month	No.	Extremes	Mean	σ_M	σ	σ_σ	Ratio, spleen to body weight
MALES							
September	1	.....	(50)	....	.....	....	0.19
October	9	17–58	33.7	4.0	12.1	2.8	0.14
November	9	20–51	35.8	3.2	9.7	2.3	0.14
December	5	31–84	50.4	9.2	20.6	6.5	0.19
January	18	22–69	41.4	2.7	11.4	1.9	0.15
February	7	22–49	35.0	3.3	8.7	2.3	0.13
March	20	28–63	46.8	0.6	2.8	0.4	0.17
April							
(a) All birds	32	17–97	39.2	3.5	19.7	2.5	0.14
(b) no, little, and moderately fat	20	21–97	44.5	5.1	22.7	3.6	0.16
(c) fat, and very fat	12	17–45	30.5	2.3	8.0	1.6	0.10
May	8	9–38	19.6	3.5	9.9	2.5	0.08
June	1	.....	(17)	.....	.....	....	0.06
July	2	27–30	28.5	1.1	1.5	0.8	0.11
Total	112						
FEMALES							
September	1	.....	(56)	....	.....	....	0.24
October	3	27–34	30.3	1.7	2.9	1.2	0.12
November	3	22–37	27.7	3.9	6.7	2.7	0.11
December	1	.....	(19)	....	.....	....	0.09
January	4	14–36	24.5	4.4	8.9	3.2	0.10
February	1	.....	(38)	....	.....	....	0.16
March	8	23–51	32.8	3.0	8.5	2.1	0.13
April							
(a) all birds	24	16–58	34.6	1.9	9.5	1.4	0.13
(b) no, little, and moderately fat	15	25–58	38.3	2.1	8.3	1.5	0.15
(c) fat, and very fat	9	16–40	28.3	2.6	7.9	1.9	0.10
May	3	23–41	32.3	4.3	7.4	3.0	0.13
June	—	.....	.....	....	.....	....	.....
July	2	19–29	24.0	3.5	5.0	2.5	0.10
Total	53						

The group with the highest value for this ratio consists of the three fat males collected on April 13, 1951, several days after the last banded wintering birds had been seen. As already explained, these were presumably birds from more southern wintering grounds passing through Santa Barbara on the first lap of the journey north. Their ratios of liver to body weight averaged 4.11. The ratio for the eight Mountain Village males collected in May (2.99) is lower than that of any of the April values, despite their lower mean body weight (25.94 gm. as compared with 28.42 gm. for all April adults, or 30.30 gm. for fat April adults).

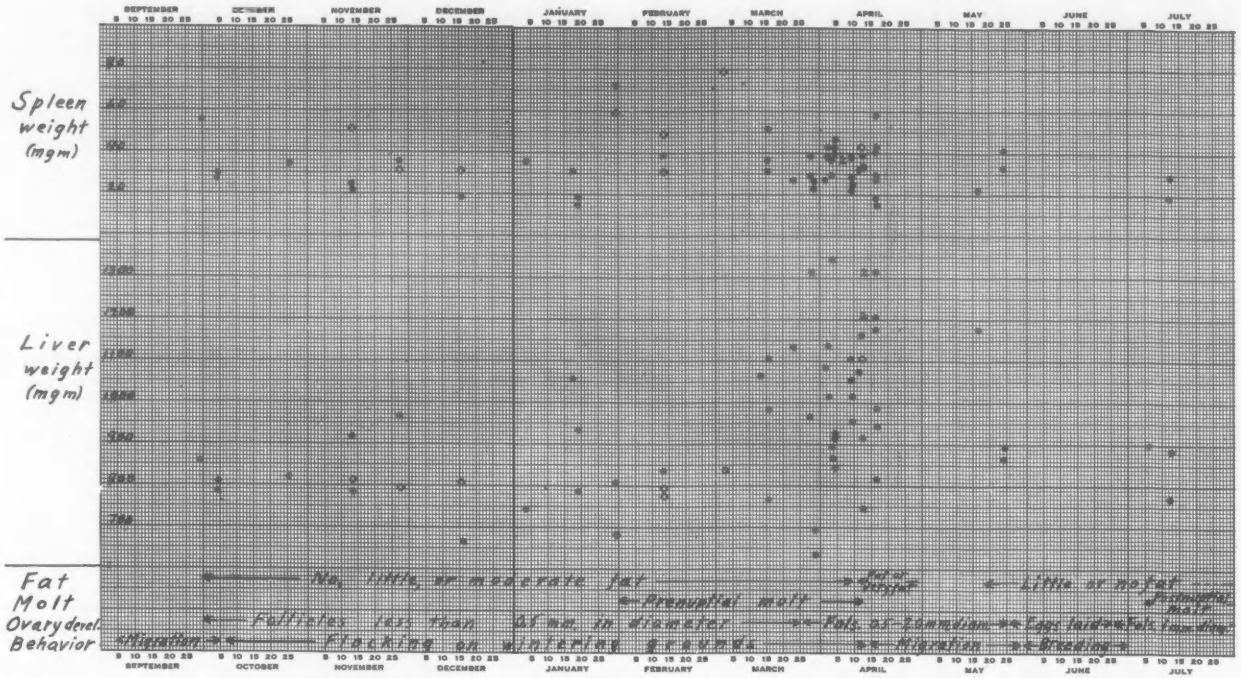

Fig. 2. Liver and spleen weights in relation to other elements of the annual cycle in females. For explanation of symbols, see figure 1.

There is some indication that a decrease in ratio of liver to body weight may also occur between July and September but the numbers involved are too small to be conclusive.

Females.—The results are graphed in figure 2 and summarized in tables 1, 2, 5 and 6. Although the much less abundant material for females justifies no detailed comparisons with the males, a few points are worth brief mention: The means for females for abso-

Table 4

Means of Body, Liver and Spleen Weights and Testis Volumes for Successive Periods of the Annual Cycle in Adult Males

Period	No.	Body weight (gm.)	Liver weight (mgm.)	Spleen weight (mgm.)	Testis volume ($mm.^3$)
I. Arrival on wintering grounds (Sept.-Oct.)	10	26.48±0.54	834.7±36.9	35.3±3.9	0.59±0.09
II. Wintering (Nov.-Dec.)	14	26.30±0.14	878.2±32.2	41.0±4.3	0.46±0.04
III. Preparation for migration: gonad recrudescence, molt and assumption of fat.					
A. Early (Jan.-March)	46	27.00±0.21	997.1±19.8	43.9±1.9	0.76±0.08
B. Middle (April; birds with no, little, or moderate fat)	20	27.30±0.35	1067.2±31.2	44.5±5.1	1.47±0.08
C. Late (April; fat or very fat birds)	9	30.04±0.78	1106.0±57.3	30.1±2.9	1.38±0.02
IV. Start of migration (April; migrants passing through Santa Barbara)	3	31.07±0.45	1277.7±16.5	32.0±3.2	1.88±0.43
V. Arrival on breeding grounds (May)	7	25.77±0.31	735.0±23.6	17.6±3.4	151.97±22.26
VI. Breeding (June)	1	28.9	951	17	266.1
VII. Gonad regression and molt (July)	2	26.00±0.29	847.5±19.4	28.5±1.1	17.93±1.43

Table 5

Means of Body, Liver and Spleen Weights and Follicle Diameters for Successive Periods of the Annual Cycle in Adult Females

Period	No.	Body weight (gm.)	Liver weight (mgm.)	Spleen weight (mgm.)	Diam. largest follicle (mm.)
I. Arrival on wintering grounds (Sept.-Oct.)	4	24.10±0.57	812.3±12.6	36.8±5.7	Less than 1
II. Wintering (Nov.-Dec.)	4	23.77±0.78	828.5±60.0	25.5±3.4	Less than 1
III. Preparation for migration:					
A. Early (Jan.-March)	15	24.48±0.36	917.2±47.3	30.6±8.2	Less than 1
B. Middle (April; birds with no, little or moderate fat)	16	25.23±0.77	996.4±35.8	38.3±2.1	Less than 1
C. Late (April; fat or very fat birds)	7	27.77±0.87	1136.3±61.9	26.3±2.9	Less than 1
IV. Start of migration (April; migrants passing through Santa Barbara)	2	26.95±0.47	1039.0±87.0	35.5±2.5	Less than 1
V. Arrival on breeding grounds (May)	3	25.50±0.61	979.7±80.9	32.3±4.3	1.86 mm.
VI. Breeding (June)	---	....	....	....	.....
VII. Gonad regression and molt (July)	2	22.90±0.99	827.5±42.8	24.0±3.5	1.0 mm.

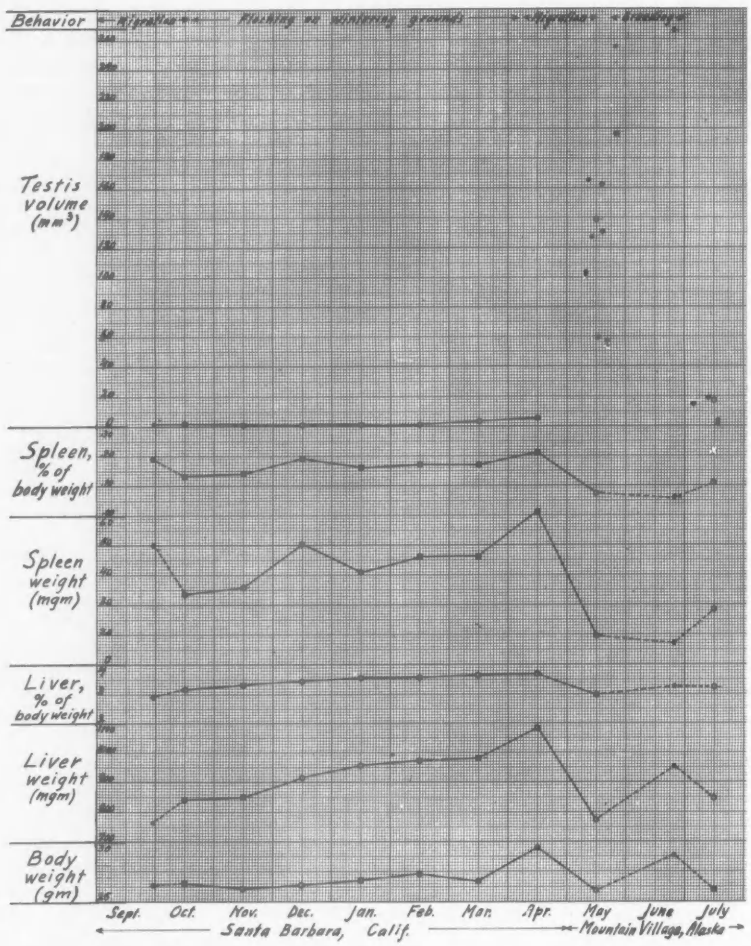

Fig. 3. Testis volume and monthly means of body weight and of absolute and relative organ weights for adult males in 1949–1950. Circles, monthly means; solid dots, individual specimens.

lute liver weights are slightly lower in five of the seven months for which more than one specimen is available (table 2). There is a parallelism between male and female, in the direction of the changes in mean liver weights between November and April, April and May, and period II and the subdivisions of period III (tables 2, 4 and 5). There is close approximation of values for both sexes for the percentage increase in liver weights between November birds and the fat and very fat April wintering birds (table 6). However, the percentage decrease between the fat April birds and those newly arrived at Mountain Village is of much smaller magnitude in females (table 6).

Females show a higher value for the ratio of liver to body weight in most months (table 2). This is especially striking for May. If more abundant material should substantiate this point and the lesser decrease of liver weight in the course of spring migration, a sexual difference in the response to the exigencies of migration may be indicated. It is also possible, however, that the females, which appear to migrate later, on the average, than do the males, may encounter less severe weather en route. Banding, observation and analysis of fat accumulation and progress of molt indicate that the first birds of a given winter flock to be ready to depart are males. Toward the end of the departure period, the birds taken from flocks not previously depleted by collecting are preponderantly females. Furthermore, in 1950 the males arrived at Mountain Village from

Table 6

Percentage Change in Mean Liver Weights

	Males		Females	
Month or category	Mean liver weight (mgm.)	Per cent change over preceding value	Mean liver weight (mgm.)	Per cent change over preceding value
November	850.6		886.0	
January	984.8	+15.8	862.0	− 2.7
March	1043.1	+ 5.9	957.7	+11.1
April (thin birds)	1067.2	+ 2.3	996.4	+ 4.0
April (fat wintering birds)	1106.0	+ 3.6	1136.3	+14.0
November	850.6		886.0	
April (fat wintering birds)	1106.0	+30.0	1136.3	+28.3
May (breeding birds)	775.4	−30.7	979.7	−13.8

five to fourteen days ahead of the females. Since the period of migration coincided with the steepest part of the curve of increase in daily mean temperature at Mountain Village, a difference of a week or two in arrival time meant the females were subjected to less severe weather conditions on the breeding grounds and, presumably, on at least the last lap of the journey north.

The smaller numbers of females do not permit the statistical treatment shown for males. The difference between mean liver weights for November and for all April females is nearly significant $\left(\frac{d}{\sigma_d} = 2.71\right)$. The difference between April and May is not statistically significant on the basis of the material available.

SPLEEN WEIGHTS

Spleen weights of individuals taken in the same month vary even more widely than do liver weights (table 3). Therefore, collection of further material is necessary before the following points can be considered as other than tentative.

Figure 3 shows a general rise in mean values for male spleen weights from October, 1949, through April, 1950. Table 4 shows an increase in mean spleen weights of males from period I through period IIIB, but this is not statistically significant on the basis of material now available. The females show increases in mean values from period II through period IIIB (table 5).

A statistically significant drop in mean spleen weights of males, between thin April birds and those newly arrived on the breeding grounds, parallels that of the liver (table 4). The difference between the two means is 26.9 mgm. and $\frac{d}{\sigma_d} = 3.06$. A decrease in the ratio of spleen to body weight occurs in the same segment of the cycle

(table 3). In females, the decreases from thin April birds to May birds, both in absolute weights and in ratio of spleen to body weight, are too small to be significant.

In all months for which material is available except May, the females show lower values for mean absolute spleen weights than do the males. The same is true for relative spleen weights.

COMPARISON WITH RING DOVES

Our findings are similar to those reported by Riddle (1928) for Ring Doves in that in most months the females show higher means for relative liver weights than do the males. Our results differ from those obtained by Riddle in the following respects.

Table 7

Statistical Analysis of Differences in Liver Weight in Adult Males

Category	N_1	N_2	M_1	M_2	d	σ_d	$\frac{d}{\sigma_d}$
I. Pairs of consecutive months							
1. January and February	18	7	984.8	890.7	94.1	52.1	1.81
2. February and March	7	21	890.7	1043.1	152.4	52.7	2.89
3. March and April	21	32	1043.1	1097.8	54.7	41.9	1.31
4. April and May	32	8	1097.8	775.4	322.4	60.3	5.35
II. Pairs of non-consecutive months							
1. November and January	10	18	850.6	984.8	134.2	46.6	2.87
2. November and March	10	21	850.6	1043.1	192.5	46.6	4.13
3. November and April	10	32	850.6	1097.8	247.2	53.4	4.63
4. January and April (fat and very fat birds)	18	12	984.8	1148.9	164.1	56.0	2.93
III. Pairs of periods from table 4							
1. Nov.-Dec. and Jan.-March	14	46	878.2	997.1	118.9	40.1	2.96
2. Jan.-Mar. and fat April winter residents	46	9	997.1	1106.0	109.9	52.6	2.09
3. Jan.-Mar. and fat April migrants	46	3	997.1	1277.7	280.6	77.7	3.61

In the White-crowned Sparrow the mean absolute liver weights of females are in most months lower than those of males, whereas in Ring Doves, Riddle found they were usually higher. In the White-crowned Sparrow both absolute and relative spleen weights average lower in females than in males, except in May. In Ring Doves Riddle found that spleens of females were not only relatively, but also absolutely, larger than those of males at all seasons. In male White-crowned Sparrows the livers and spleens are heaviest in April and lightest in May, whereas in the nonmigratory Ring Doves, Riddle found these organs largest in spring and summer and smallest in autumn and winter.

DISCUSSION

While we have no direct evidence for migratory White-crowned Sparrows as to the nature of the changes in the liver responsible for its gain or loss of weight, it seems reasonable to assume from what is known of the physiology of other birds and mammals that seasonal variations in liver weight reflect changes in the food reserves available in times of emergency or heightened activity. The point to be emphasized is that the highest and lowest values for liver weight come at precisely the times when we should expect them, if the bird draws heavily upon reserves in the liver during the flight north.

This does not imply, however, that reserves in the liver gradually diminish from a maximum as the bird flies north and are not at least partially replenished en route. The studies of Irving and Paneak on arctic migrants (report presented at the Third Alaskan Science Conference, September, 1952) do not support such a concept. The seasonal

changes in liver weight herein reported are rather to be viewed as one conveniently measurable sign of endocrine changes which precede, and accompany or immediately follow, migration.

The lighter liver and spleen weights of the new arrivals at Mountain Village as compared with those of the Santa Barbara birds could, however, be due, in part at least, to several factors not directly related to migration. Besides the difference in dates of collection, at least three other possible variables must be considered: differences in (1) collection methods; (2) genetic constitution of the Mountain Village and Santa Barbara populations; and (3) stage of reproductive cycle.

The first variable is probably relatively unimportant, at least with respect to the liver, since if variations in collection methods influenced the results to any appreciable degree, they probably minimized the difference between trapped and shot birds. The trapped birds struggled to escape during the few seconds they could see me coming, whereas the shot birds had to be nearly motionless and presumably unsuspicious, at least just before death, or I could not have shot them. The effects of different collection methods on spleen weights is more doubtful; the momentary fright of the trapped birds may perhaps have been matched by the bleeding of the shot birds, although the small size and number of shot entering the specimens caused very slight bleeding.

The second consideration, that of difference in genetic constitution, cannot be dismissed, although it seems highly improbable that such a difference could be responsible for so large a variation in liver weights as was found between April and May. It is worth noting that no external structural differences between the two groups have been detected. The color and pattern of plumage are identical, and the means of those body dimensions least subject to seasonal wear are so close as to suggest near identity. (Means for length of tarsus, middle toe and beak for 83 adult males from Santa Barbara are 22.18 ± 0.06, 15.73 ± 0.04, and 7.94 ± 0.02 mm., respectively. For 13 males from Mountain Village the means for these dimensions are 22.51 ± 0.12, 15.75 ± 0.08, and 7.95 ± 0.04 mm.). Nonetheless there is always the possibility that different breeding populations of the same race, however similar in external appearance, may differ in less obvious characters. Riddle (1947) has found significant differences in relative liver weights in races of Ring Doves developed in his laboratory, but these races also differ in a variety of readily observable characters.

The effect of the third variable, that of stage of reproductive cycle, cannot be assessed at present, although it is of interest that Riddle found in the nonmigratory Ring Doves that liver and spleen weights were highest in spring and summer, when ovary and testis are largest. Fortunately we have in California an almost perfect natural control, a permanently resident race of White-crowned Sparrow, *Z. l. nuttalli*, the testis cycle of which is identical as to histologic stages, although not as to timing, with that of *Z. l. gambelii*. Analysis of organ weights in relation to testis stage in *Z. l. nuttalli*, now in progress, may throw light on this aspect of the problem.

SUMMARY

Seasonal changes in liver and spleen weight have been analyzed for strongly migratory wintering and breeding populations of *Zonotrichia leucophrys gambelii*. At Santa Barbara, California (lat. 34°30′N.) 191 specimens were taken from September through April during three consecutive years. At Mountain Village, Alaska (lat. 62°07′N.), 17 were collected from May through July, 1950.

In adult males significant seasonal differences in liver weight, analyzed in several ways, were found. Monthly means increased from November through April and dropped sharply in May; means for fat April males ready to migrate averaged 30.0 per cent

higher than for November males, and 30.7 per cent higher than for males newly arrived on their breeding grounds. Parallel variations in the ratio of liver to body weight occurred, the highest and lowest values coinciding with the beginning and the end of migration, respectively.

Females paralleled males in direction and timing, but not in magnitude, of changes in absolute liver weight. In most months females averaged higher as to relative liver weight. The possibility of a sexual difference in the response to exigencies of migration is suggested.

Although spleen weights are more individually variable than liver weights, both sexes showed increases in mean spleen weights for certain of the successive periods of the annual cycle. A significant difference between mean spleen weights of thin April males and that of May males was found.

The data for the White-crowned Sparrow are briefly compared with those reported by Riddle for Ring Doves.

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USE OF CAVES BY HUMMINGBIRDS AND OTHER SPECIES AT HIGH ALTITUDES IN PERU

By OLIVER P. PEARSON

Most hummingbirds live in the tropics. Those living in cold climates are faced with the problem of supporting their exceedingly high rate of metabolism over long periods of darkness and bad weather. Four courses are open to them:

Feeding before dark.—This course is adopted by most small birds. By intensive feeding before dark, small passerine birds are able to maintain a nearly normal metabolism until daybreak. The colder the night temperatures encountered, the more food energy is required for survival until daylight.

Feeding at night.—At high latitudes "night" feeding is possible in the summer because the days are long. At low latitudes, as in Peru, the nights encountered by the nonmigratory birds are 11 hours or more long throughout the year. No hummingbirds or passerine birds are known to have adopted the course of feeding in darkness.

Retreat to warmer places.—Many birds seek shelter at night, but frequently it is impossible to say whether this is primarily to avoid low temperature or to avoid predators. A few retreat to holes or caves where the thermal advantages are obvious. On Mount Orizaba in Mexico, hummingbirds feed as high as 14,500 feet, but in cloudy weather and at night they retreat to lower altitudes (Swan, Ecology, 33, 1952:109). In Peru, however, many hummingbirds would have to fly more than 70 miles to reach an altitude under 12,000 feet.

Torpidity.—If a bird is physiologically capable of lowering its body temperature at night and raising it again to normal in the morning, it can survive the night with relatively little drain on its energy resources. Some hummingbirds do this (Pearson, Condor, 52, 1950:145). However, while in a torpid condition the birds must not be exposed to temperatures below freezing or they will either perish or be forced to awaken and thereby lose the advantages of torpidity. A bird essaying nocturnal torpidity in a region of freezing temperatures must, therefore, also be endowed with the instinct and ability to find retreats where the temperature will not fall below 0°C.

In view of these considerations it is of interest to examine the habits of hummingbirds in southern Peru where these birds live even above 15,000 feet. In this region the eastern and western Andes enclose a high plateau more than 150 miles across that never drops below an altitude of 12,500 feet. This is for the most part a land of bare earth and rock, bunch grass, scattered low shrubs, and mats of cushion-shaped plants that hug the ground to escape wind and cold. Despite the tropical latitude, nights are always cold, and in the higher parts of the plateau night temperatures drop below freezing almost every night of the year. In the dry winter season (May to September) the days are sunny with temperatures usually between 12° and 18°C., the nights clear, crisp, and far below freezing. Summer, which is the nesting season of most of the birds of the region, coincides with the wet season. Consequently, nesting is at a time of much hail, snow, and cold rain. The accompanying cloudiness prevents night temperatures from falling much below freezing even at the higher altitudes, but the frequent afternoon snowstorms drive birds to shelter, thereby taxing their resources by imposing a fast of 15 hours or more before the return of favorable feeding weather the following morning.

ESTELLA HUMMINGBIRD

The commonest hummingbird at high altitudes between Lake Titicaca and the Pacific slopes of the Andes in Peru is *Oreotrochilus estella*, a bird about the size of the Blue-throated Hummingbird (*Lampornis clemenciae*). It uses caves, crevices, and mine

tunnels not only for shelter at night, but for nesting. Several hummingbirds were seen in such places in the daytime, and in addition three nesting and five non-nesting adult hummingbirds were captured in caves and tunnels at night. All were female *Oreotrochilus estella*. Two other nesting hummingbirds, probably females, escaped at night without being captured. It is likely, therefore, that the males have other roosting habits.

Temperatures.—In regions where temperature extremes are common, caves and tunnels provide an intermediate and more constant temperature. On December 8, 1951, the temperature conditions in a tunnel sheltering hummingbirds at night at 11,200 feet on the western slope of the high plateau just described were as follows:

	12:30 night	12:30 day
In tunnel at nest	15°C.	16½°C.
In shade outside tunnel	5°C.	18°C.

In winter, outdoor temperatures at night would be much colder, yet this tunnel undoubtedly would remain well above freezing.

Temperatures of five *Oreotrochilus* captured in caves or tunnels at night are shown in table 1. The one bird listed with a body temperature almost as low as the surrounding temperature was completely torpid and was hanging on a vertical rock surface of the

Table 1

Temperatures of Estella Hummingbirds Captured in Tunnels at Night

Date	Time	Remarks	Tunnel temperature	Bird temperature	
Dec. 9,	12:30 a.m.	Torpid, 25 feet from entrance.	14°C.	14½°C.	(esophagus)
Dec. 9,	12:40 a.m.	Awake.	14°	36°	(esophagus)
Jan. 1,	10 p.m.	Awake, on nest with young.	....	39½°	(cloaca)
Jan. 1,	10 p.m.	Awake, young of above almost fledged.	....	38°	(cloaca)
Jan. 3,	1 a.m.	Awake, on nest with fledged young.	14°	36°	(esophagus)
Jan. 3,	9 a.m.	Awake, same bird kept captive.	....	37°	(esophagus)

rough ceiling 25 feet from the entrance of a mine tunnel. She was hanging by the feet and using the tail flicker-fashion for support. Her return to an active condition was similar to that described for Anna and Allen hummingbirds (Pearson, *op. cit.*). Her ovaries were relatively inactive, containing follicles only ½ mm. in diameter. The ovaries of the non-torpid birds at this time likewise contained follicles about ½ mm. in diameter, except in one instance they were 1½ mm.

Nesting.—The nests of *Oreotrochilus estella* occur in large caves, small caves only 4 or 5 feet high and as deep, in mine tunnels, large crevices in cliffs, or, in one instance, in an unoccupied stone hut. One nest in a mine tunnel (fig. 1) was 18 feet from the entrance and was fastened to the ceiling 5½ feet above the floor. The tunnel was so dark at this point that I could not even see the nest until my eyes had become accustomed to the darkness. In another tunnel the nest was 20 feet from the entrance. Along Lake Titicaca in a "sea" cave 4 feet wide, 15 feet high, and 20 feet deep a nest was attached 12 feet above the floor and about 15 feet from the opening. I have not found more than one nest in each tunnel or cave, but in early December, when nests were without eggs or young, each of two tunnels contained three hummingbirds.

Between December 7 and 9, 1951, on the Rio Torata, 11,200 feet, I found four abandoned mine tunnels. A hummingbird occupied a nest in one of them, and the other three contained currently unused nests. On January 1, 1952, near Juli, 12,500 feet, I found four "sea" caves that are a few feet above the present level of Lake Titicaca. Each of these contained a hummingbird nest. In other locations as well, a high propor-

tion of the available caves were utilized by hummingbirds. Such frequent utilization suggests that the number of hummingbirds living in this region may be limited by the number and distribution of suitable caves.

Nests of *Oreotrochilus estella* were composed primarily of a large handful of wool (sheep, llama, alpaca), moss, lichens, leaves, grass, and feathers (many of them not hummingbird feathers). Their texture was similar to that of nests of North American

Fig. 1. Nest of Estella Hummingbird on the ceiling of a mine tunnel. A 6-inch ruler is inserted in the nest cup.

hummingbirds, but they were much bulkier (fig. 1) despite the fact that this species is not large (six specimens weighed between 6½ and 8½ grams). Nests were almost always glued to the ceiling of the cave or tunnel, but in a few cases were glued to overhanging walls near the ceiling. Goodall, Johnson, and Philippi (Las Aves de Chile, vol. 1, 1946) state that the nests are similar to those of *Oreotrochilus leucopleurus* and that in both of these species the nests are cemented to rock outcrops. I know of no other hummingbirds that fasten their nests with mucilage, although the habit is common among swifts.

Two observations suggest that the same nest is used for several clutches. The mummified remains of a hummingbird were found clinging to the side of a nest that was in use, and in no cave or tunnel was more than one nest found. In such sheltered locations

old nests should last for years unless they are scavenged for subsequent nests. It seems more likely that they are reconditioned and used over again.

Nesting occurrences were as follows:

December 7-9, Rio Torata, 11,200 feet. Three unoccupied nests and one nest occupied but without eggs.

January 1, 3 miles east of Juli, 12,500 feet. One nest with 2 eggs in early stages of incubation; one nest with 2 young almost fledged; 2 nests without eggs or young.

January 2, 55 miles ENE of Arequipa, 15,400 feet. A female with incubation patch, 2 mm. follicle, carrying nest material; collected by Carl B. Koford.

January 3, Pomata, 12,500 feet. Two nests, each with 2 young capable of flying.

January 5, 10 miles south of Ilave, 12,600 feet. One nest with parent incubating. Nest contents not seen.

February 6, Rio Huanque, 30 miles south of Ilave, 13,000 feet. One nest with a single young ready to fly; another nest with one or more naked young.

OTHER BIRDS

Several other kinds of birds were found roosting at night in the same caves and tunnels as the hummingbirds: three Sparrow Hawks (*Falco sparverius*) in one cave, one in another; Horned Owl (*Bubo virginianus*); in different caves, two immature female Streaked Spinetails (*Leptasthenura andicola*); and two kinds of ground tyrants (a female *Agriornis montana* and a male *Muscisaxicola rufivertex*). In addition the following species were found in caves and tunnels not occupied by hummingbirds at the time: Bolivian Goose (*Chloephaga melanoptera*), a male Cinereus Ground Tyrant (*Muscisaxicola cinerea*) feeding nestlings in a cave on February 7, a male Black-fronted Ground Tyrant (*Muscisaxicola frontalis*), and a Gray-headed Finch (*Phrygilus gayi*). None of these was torpid or had a low body temperature.

If to the above are added common genera that make use of small holes and crevices, such as Flickers (*Colaptes*), Miners (*Geositta*), Creepers (*Upucerthia*), Cinclodes (*Cinclodes*), Cliff Swallows (*Petrochelidon*), and Ground Finches (*Sicalis*), it will be seen that a considerable proportion of the small birds living in these mountains resort to retreats of equable temperature.

Museum of Vertebrate Zoology, Berkeley, California, September 26, 1952.

NOTES ON THE LIFE HISTORY OF COLUMBIGALLINA TALPACOTI IN SURINAM

By FR. HAVERSCHMIDT

The Talpacoti Ground Dove (*Columbigallina talpacoti*) has an extensive range, occurring from tropical Mexico south to eastern Peru and northern Argentina. Peters (1937:108) recognizes four races of which the nominate, *C. t. talpacoti,* is found in Surinam.

The general color of the male is deep vinaceous-chestnut, somewhat paler on the under surface; the crown of the head and the nape are bluish ash-gray. On the scapulars and the upper wing coverts there are several dark spots. The female differs from the adult male in being earth brown above and below, while the head is grayish brown. It is a typical ground dove in general appearance, somewhat larger than *passerina* and *minuta,* the two other members of the genus *Columbigallina* which are found in Surinam. The weights of specimens collected by me in this country were: two males—41 and 48 grams; four females—44, 45, 50, and 51 grams.

In Surinam this little dove is well known under the name "stondoivie" (stone dove). In the coastal area it is particularly numerous wherever there are open sandy places on the thickly overgrown sand reefs, which run parallel to each other and more or less parallel to the present coast line amid swampy country; it occurs also in sandy savannas of more interior regions. This dove has adapted itself, furthermore, to cultivated lands and to waste places near human settlements. It is in fact the only member of the genus *Columbigallina* in Surinam which is quite a common garden bird, nesting even in the middle of the town of Paramaribo. In this respect it differs from *C. passerina,* which seems wholly confined to sand reefs and savannas and is certainly not a familiar and confiding backyard bird as it is reported to be in the southeastern United States (Bent, 1932:435).

C. talpacoti, like *minuta,* is much less a ground dove, ecologically, than is *passerina,* for it seems wholly dependent on the ground only for feeding and collecting nest material. A large part of its life is spent in shrubs and trees. The birds are usually seen singly or in pairs, but in favorable localities a number of birds, up to 20 or 25 individuals, are often seen feeding together.

Voice and display.—The cooing of the male begins with "hŏ-ŏ" and is repeated with quickening tempo so that near the end of a series of notes, each one sounds more like "hoo." When the bird is cooing the neck is thickened and the tail goes up and down with the sound. The male often terminates cooing by taking flight, whereupon he rises a short distance in the air, claps his wings a few times loudly and vigorously, then soars downward with outstretched wings for a short distance before resuming flight with rather slow wing movement. I presume this to be a kind of courtship flight. While the male performed in this way, however, I did not see a female nearby.

Copulation and related behavior.—All instances of copulation seen by me have taken place on branches of trees. The two birds sit close to each other, each rapidly flicking its wing tips, lifting them only a few millimeters from the body. Then they start billing. Each may alternate this by turning its head and preening behind one of its own wings. The male then mounts the female. After copulation, wing flicking continues while billing and wing preening may start once again. Wing flicking is always an indication that the birds are excited or peculiarly stimulated. It is seen in many circumstances; for example, it precedes and accompanies both fighting and feeding of the young. Once formed, the pair is almost inseparable. I well remember two doves which, in a very

heavy rainshower on June 15, 1947, were sitting so close against each other in order better to shed the rain drops that they looked like one solid mass.

Belligerency.—Males are rather quarrelsome with other males and often fight. This is the usual type of dove fight in which each bird tries to strike the other with one or both of its wings and each flies upwards in order to try falling down upon its opponent. Nervous wing flicking is evident throughout the struggle. A threatening attitude against other birds venturing to approach too closely, or against me when I inspected the nest, consisted of the lifting of the nearer wing toward, or against, the intruder, while the body leaned away.

Breeding season.—During practically all months of the year nests with eggs can be found, but my own data are too few to demonstrate nesting peaks or other characteristics of the breeding season. Hellebrekers' account (1942) of the Penard egg collection from Surinam gives no details in this regard. Several broods are reared in a year by one pair. In my garden the same nest was used by a pair of these doves for three broods in relatively quick succession, as follows:

Brood 1. First egg laid on October 25, 1951; hatched on November 7; young left nest on November 18.

Brood 2. First egg laid on December 2, 1951; eggs hatched on December 15; young left nest on December 27.

Brood 3. First egg laid on January 31, 1952; eggs hatched on February 13; young left nest on February 24.

The interval between fledging of the first brood and starting of the second was 13 days and between fledging of the second and starting of the third brood, 34 days.

Nest site and nest.—The nest is always built in trees or shrubs. In trees it is sometimes placed on a *Bromelia* at a great height. In this respect *C. talpacoti* again resembles *minuta* but differs from *passerina*, at least in Surinam, where *passerina* invariably nests on the ground, as it likewise does in British Guiana (Young, 1928:758). Many nests are built in shrubbery at a height of only a meter.

The nest itself is sometimes a loose structure consisting of only a few sticks or grass stems resting on a solid base of big leaves of a living plant. In Beebe (1917) there is a photograph of such a nest. This type of nest I found on October 8, 1951, in my garden on some big leaves of a *Lagerstroemia* about three meters above the ground. Nests of this type are in danger of falling down with the leaves; this happened to the last-mentioned nest, which came down on October 19 when the young were two days old. More often the nest is a compact clump of small dry sticks, roots, and grass stems, with a fine cup in the middle. That it is sturdy is proven by the fact that, as mentioned already, a nest in my garden was used for three broods in succession. It was built on a horizontal branch of a *Lagerstroemia* at a height of about 1.5 meters and was well hidden by the big leaves. When the young of the last brood were at the point of leaving, the nest fell down, but at that stage the young were able to support themselves on nearby branches.

Sometimes old nests of other birds are used. On September 25, 1952, a dove was sitting on an old nest of *Ramphocelus carbo* in a *Lagerstroemia* in my garden; the young had left this nest in the first days of September. The doves used the same nest for their second brood. On October 21 the dove was again incubating on this nest, and *Ramphocelus* was sitting on a new nest in the same tree at a distance of about 60 centimeters from the dove.

Nest building.—Both sexes share the task of building. The nest material is always collected on the ground, and only one stick or piece of dry grass at a time is taken to the nest. The male may or may not be an assiduous builder. I have often seen males collecting nest material and starting nests without completing them. In one instance nest build-

ing lasted only two days, for on July 20, 1952, a nest was started which contained the first egg on July 22.

Egg laying.—The clutch almost invariably consists of two eggs, but in the first nesting of the closely observed pair in my garden only a single egg was laid. The first egg of the third brood was laid on January 31 before 6:30 a.m.; the second, on February 1 between 7 a.m. and 4:30 p.m. In another brood the first egg was laid on July 22 before 3 p.m. and the second on July 23 between 7 a.m. and 5:30 p.m. Laying of eggs on consecutive days thus seems the rule in this species.

Weights of four fresh eggs were: 3.22, 3.25, 3.5, and 3.72 grams. Measurements of eggs are given by Hellebrekers (1942), these overlapping for the species *talpacoti, passerina,* and *minuta.*

Incubation and hatching.—In all the three broods that I watched, the female began sitting on the empty nest one day before the first egg was laid and spent that night on it. For instance, in the second brood the female was sitting at 11:45 a.m. on December 1, whereas the egg was laid on December 2; in the third brood the bird was sitting at 7:45 a.m. on January 30, whereas the first egg was laid on January 31. This habit *talpacoti* appears to have in common with *minuta,* of which I disturbed a bird sitting on an empty nest on October 25, 1946.

As in other doves, the female was found sitting on the eggs from the afternoon through the whole night, to be relieved in the morning by the male. The male sat through the morning and was relieved by the female in the afternoon. The male almost invariably arrived between 10 and 11 a.m., and the female relieved him between 3 and 4 p.m. Nest relief took place in the following way: the reliever alighted in the tree, preened for some time, then walked toward the nest. Generally the incubating bird flew straight from the nest on the approach of its mate. A few times the incubating bird was reluctant to leave and had to be pushed from the eggs by its mate.

In the first brood, consisting of only a single egg, incubation was 13 days (October 25 to November 7); in the second brood of two eggs, 13 days (December 2 to 15); and in the third brood of two eggs, 12 days (February 1 to 13). In this respect *C. talpacoti* again resembles its relative *minuta.* Of the latter species I found the incubation period in one pair to be 13 days (October 28 to November 9).

As to the hour of hatching in *talpacoti,* in the first brood the single nestling hatched on November 7 at about 6:45 a.m.; the young bird was still wet and pieces of shell were in the nest. Of the second brood both young hatched on December 15 between 1 and 3:30 p.m.; by 3:30 the shells of the eggs were already gone. The first nestling of the third brood was out of the shell on February 12, between 3 and 4:30 p.m., but the second did not emerge until February 13, between 7 a.m. and 3:30 p.m. Disposal of empty eggshells was not observed. Presumably they were taken away by one of the parent birds, as I never found them on the ground under the tree.

Rearing of young.—The young grow rapidly. Daily weights of the nestlings in all three broods are shown in table 1. From these figures it is evident that the single youngster of the first brood grew faster than the nestlings of the two following broods having the normal number of two young. The eyes of the young are closed until the fourth day and are completely open on the fifth.

As during the incubation period, there was always one of the parents on the nest, and it was always the female who spent the night on it. In all three broods the female was on the nest during the night before the young left the nest. During the daytime, one of the parents was invariably found on the nest until a short period before the nestlings left. This period may vary from two days to less than one day. For instance, in the first brood the single youngster left the nest on November 18. During the day of Novem-

ber 16 this nestling was left alone on the nest for the first time. The young of the second brood left on December 27, having been left alone for the first time somewhat earlier the same day.

The frequency with which the nestlings are fed during the first few days tends to coincide with that of normal nest relief. On December 16, the second day after hatching,

Table 1

Daily Weight of Nestlings of *Columbigallina talpacoti*

Age in days	Brood 1 (one nestling)*	Brood 2 (two nestlings)		Brood 3 (two nestlings)	
0	4	3.0 gm.	4.0 gm.	3.5 gm.	4.0 gm.
1	6	3.6	4.9	4.7	5.0
2	9	6.5	8.0	6.9	7.3
3	14	9.2	10.4	11.0	11.8
4	19	12.4	12.7	12.1	13.5
5	21	14.9	15.5	16.6	16.9
6	23	17.3	20.0	20.5	20.0
7	27	19.9	21.2	22.5	24.6
8	27	21.5	22.5	27.2	24.5
9	27	23.5	24.5	26.8	25.6
10				26.5	

* The first nestling was weighed only to the nearest gram, a different balance being used for the others.

the young were fed at 10 a.m. by the male; the female did not feed them when she relieved him at 4 p.m. Two days later, December 18, the male fed at 11 a.m. and the female at 3:30 p.m. On December 22, when the young were seven days old, they were fed between 12:30 p.m. and dark three times: by the female at 1 p.m., by the male at 3:45, and again by the female at 5:30.

The fledging period of the single nestling of the first brood was 11 days (November 7 to 18); of the two young of the second brood, 12 days (December 15 to 27); and of the third brood, 11-12 days (February 12-13 to 24). When handled from the ninth day onward the nestlings tried to jump from the nest prematurely, so I refrained from weighing them after this. From table 1 it is clear, however, that the young doves leave the nest before attaining the weight of adult birds, although they can fly rather well at that time.

The adult birds became conditioned to my daily inspections to a remarkable degree. This was especially true of the female, who began staying on the nest so that I had to take the young from under her in order to weigh them. Her only reaction was to lean away and left her wing toward me, uttering a soft "hoo." I never observed injury feigning in my garden birds, although on October 31, 1946, when my close approach had startled a dove on its nest with two well-grown nestlings, the bird fluttered from the nest to the ground where it crept forward as if it had a broken wing.

After leaving the nest, the young are still fed for some time by both parents. How long this period lasts is difficult to ascertain without marking the birds. On January 9, 1952, two well fledged doves were fed in my garden in the very tree where the second brood had left the nest on December 27. At that age the young are prone to be begging constantly from their parents. On October 26, 1948, I watched a pair of doves with two full grown nestlings, one of them sitting between its parents and the other beside the female. The fledglings were very obtrusive, one climbing on the female's back in its efforts to take hold of her bill. The young bird which sat between its parents was fed successively by both of them, while the other young was fed by the adjacent female.

SUMMARY

In Surinam *Columbigallina talpacoti* is a common bird in open sandy country. It is equally common in waste places and gardens. The species is much less a ground dove than its relative, *C. passerina*, in that it spends much time in trees and nests at various heights.

Breeding occurs almost throughout the year, during which several broods are reared. Details are given on three broods which were reared in the same nest.

Song, courtship flight, and copulation are described.

The nest is built by both sexes, while the nest material is collected from the ground. The day before the first egg is laid, the female starts sitting on the nest and remains on all night. She incubates steadily from afternoon until the morning of the next day, when she is relieved by her mate. Incubation lasts 12-13 days.

The young grow rapidly; their daily weights are given. Both parents feed the young and cover them in the nest until about a day before the young leave the nest. The female sits on the nest the last night before the young leave. The fledging period is 11-12 days.

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INDIVIDUAL VARIATION IN THE WHITE-NECKED RAVEN

By JULIAN J. BAUMEL

This paper is concerned with the quantitative aspect of individual variation in the skeleton of the White-necked Raven (*Corvus cryptoleucus*), but in addition it includes some consideration of variation in external characters and weight. Less work of this nature has been done with skeletal than with external characters because of the relative paucity of avian skeletal material in museum collections as compared with skins. I have been able to borrow an extensive series of skeletons through the generosity of Mr. E. R. Kalmbach, Director of the Wildlife Research Laboratory, U. S. Fish and Wildlife Service, Denver, Colorado. Mr. Shaler E. Aldous, Chief, Section of Wildlife Investigations, U. S. Fish and Wildlife Service, Washington, D.C., has lent me his personal field notebook, from which weight records and external measurements have been taken. Dr. Pierce Brodkorb and Dr. Arnold Grobman, Biology Department, University of Florida, have been most helpful with their encouragement and criticism. I am happy to express my sincere appreciation for the kindness all these gentlemen have shown me.

Throughout the paper the following abbreviations will be used: N = number of specimens; R = observed range; M = mean; σ = standard deviation; V = coefficient of variability; CD = coefficient of divergence in per cent. The formula for the coefficient of divergence (Klauber, 1940) is 200 $(M - M')/(M + M')$. In this paper, t-values of 3.00 or more are considered significant.

Aldous (1942) published measurements of White-necked Ravens taken in the flesh. These included weight in grams, tail length, wing length, total length, and extent of wings. Tail length was taken by bending the tail up at a right angle with the back and placing the ruler parallel with the tail, the end of the ruler touching the back of the bird at the base of the uropygium. Wing length was that of the chord. All of the linear measurements were recorded to the nearest eighth of an inch. Statistical calculations were made from Aldous's raw data.

WEIGHT

Variability demonstrated in body weight (table 1) was greater than in that of any linear external or skeletal measurement. Such factors as amount of food in the digestive tract at time of collection of the birds, age, sexual, and seasonal differences could contribute to the high amount of variation in this character. In the Fox Sparrow (*Passerella iliaca*), Linsdale (1928) found more variation in weight (V for ♂ 6.21; ♀ 8.41) than in linear skeletal measurements. Blanchard (1941) reported variability of similar magnitude in adults of *Zonotrichia leucophrys* (V of ♂ 6.54-8.75). The variability in weight of *Corvus cryptoleucus* is comparable to that of these species of fringillids.

Weight of females in *C. cryptoleucus* appears to be more variable than that of males (table 1). A statistical test was applied to determine if this sexual difference was real or might rather be attributed to errors of sampling. The values of V were found not to be significantly different (t = 0.51). Mean weights of the sexes differed significantly (t = 6.10), but the overlap of extremes prevents separation of the sexes by use of this character. The amount of sexual dimorphism is expressed by the coefficient of divergence. Males average 8.23 per cent heavier than females.

EXTERNAL MEASUREMENTS

Table 2 presents the external measurements. Greatest variation occurs in tail length; the least occurs in extent of wings. Behle (1950) reported that in males of several sub-

species of *Geothylpis trichas* variability in tail length exceeded that of wing length (V of wing, 2.63-3.90; tail, 3.37-5.16). In the Canada Goose, *Branta canadensis interior*, however, which permits segregation of sexes by use of absolute measurements, since the extremes overlap in all cases. The differences between means of the sexes in all cases are statistically highly significant (t-values from 4.71 to 6.03).

Table 1

Weights of *Corvus cryptoleucus* in Grams

Sex	N	R	M	σ	V	CD
♂	76	442–667	556.08±5.00	43.60±3.54	7.84±.64	8.23
♀	68	378–607	512.14±5.18	42.69±3.66	8.33±.71	

Hanson's data (1951) show the same situation with large series of adults and juveniles of both sexes.

For all the external measurements of *cryptoleucus* the average V is 3.02 in males and 3.01 in females. Tests of significance for each external character show that in none is one sex more variable than the other (t-values range from 0.51 to 1.16). Males in every instance have larger mean dimensions than females. Coefficients of divergence range from 2.84 to 3.20 and average 3.07 per cent. There is no external measurement,

Table 2

External Measurements of *Corvus cryptoleucus* in Millimeters

Measurement	Sex	N	R	M	σ	V	CD
Tail length	♂	53	196.9– 228.6	214.4± .99	7.19± .70	3.35±.33	3.13
	♀	56	184.2– 222.3	207.7±1.06	7.93± .75	3.82±.36	
Wing length	♂	53	336.6– 381.0	359.2±1.56	11.33±1.10	3.15±.31	3.20
	♀	56	323.9– 362.0	347.9±1.32	9.88± .93	2.84±.27	
Total length	♂	53	463.6– 533.4	506.0±1.99	14.48±1.41	2.86±.28	2.84
	♀	56	457.2– 533.4	491.8±2.02	15.09±1.43	3.07±.29	
Wing extent	♂	52	997.0–1124.0	1063.0±3.98	28.71±2.82	2.70±.27	3.09
	♀	55	977.9–1066.8	1030.7±3.20	23.72±2.26	2.30±.22	

SKELETAL MEASUREMENTS

Fifty skeletons of *Corvus cryptoleucus*, 27 males and 23 females, were available for this study. Thirty-six measurements were made on various elements of each skeleton. Vernier calipers were used in all but two instances; for these it was necessary to use dividers, then lay off the measurement on a steel rule. Since skeletal measurements are frequently described in rather general terms, an attempt is made here to define them with more precision.

Skull length.—From tip of bill to most posterior point of cranium.

Basal length.—From tip of bill to posterior surface of occipital condyle.

Cranial length.—On midline, from most posterior point of frontonasal hinge to most posterior point of cranium.

Cranial depth.—From highest point on frontal bones in the midline to bottom of fossa just anterior to occipital condyle (dividers).

Culmen length.—From most posterior point of frontonasal hinge to tip of bill.

Frontonasal width.—Transverse distance across frontonasal hinge.

Postorbital width.—Distance between the two postorbital processes.

Ramus length.—Greatest length of a mandibular ramus, including symphysis of bill.

Ramus height.—Greatest height of a ramus at level of mandibular foramen.

Table 3

Skeletal Measurements of *Corvus cryptoleucus*

Measurement	Sex	N	R	M	σ	V	CD
Skull length	♂	21	91.0– 98.4	93.06±.46	2.10±.32	2.26± .35	3.28
	♀	14	85.5– 93.8	90.06±.62	2.32±.44	2.57± .49	
Basal length	♂	21	80.8– 88.7	83.91±.40	1.81±.28	2.16± .33	3.35
	♀	15	76.6– 85.7	81.10±.62	2.42±.44	2.98± .54	
Cranial length	♂	27	38.5– 43.4	40.92±.20	1.02±.14	2.49± .34	1.89
	♀	23	39.1– 41.4	40.16±.14	.66±.10	1.63± .24	
Cranial depth	♂	27	24.4– 27.2	25.82±.15	.76±.10	2.94± .40	1.09
	♀	23	24.5– 26.5	25.54±.13	.62±.09	2.42± .36	
Culmen length	♂	21	52.9– 59.5	55.16±.43	1.96±.30	3.54± .55	5.11
	♀	15	48.9– 56.4	52.42±.51	1.96±.36	3.74± .68	
Frontonasal width	♂	27	20.9– 24.8	22.97±.17	.86±.12	3.73± .51	4.10
	♀	23	20.9– 23.2	22.05±.13	.64±.09	2.88± .43	
Postorbital width	♂	27	36.7– 40.4	38.69±.17	.88±.12	2.27± .31	1.80
	♀	22	36.5– 39.2	38.01±.16	.76±.11	1.99± .30	
Ramus length	♂	20	73.1– 82.1	76.35±.53	2.37±.37	3.10± .49	3.31
	♀	12	70.1– 77.8	73.83±.60	2.07±.42	2.81± .57	
Ramus height	♂	27	8.5– 9.7	8.98±.06	.33±.04	3.64± .50	4.66
	♀	23	7.6– 9.1	8.57±.07	.32±.05	3.77± .56	
Basihyal length	♂	26	11.2– 14.5	13.24±.14	.73±.10	5.54± .77	5.47
	♀	21	10.4– 14.0	12.53±.19	.89±.14	7.11±1.10	
Keel length	♂	26	53.8– 63.5	57.37±.44	2.22±.31	3.86± .54	3.38
	♀	23	52.4– 60.5	55.47±.37	1.79±.26	3.23± .48	
Keel depth	♂	27	15.6– 18.8	17.53±.16	.81±.11	4.59± .63	4.63
	♀	23	15.0– 18.7	16.74±.19	.91±.13	5.42± .80	
Mid-sternum width	♂	27	26.8– 32.4	28.92±.25	1.31±.18	4.52± .62	.90
	♀	22	27.0– 30.8	28.66±.23	1.06±.16	3.69± .56	
Clavicle length	♂	26	43.0– 50.3	45.99±.27	1.38±.19	2.99± .42	4.70
	♀	21	41.3– 46.3	43.88±.31	1.43±.22	3.27± .50	
Coracoid length	♂	27	43.3– 49.4	46.73±.25	1.28±.18	2.75± .37	3.66
	♀	23	43.2– 46.6	45.05±.21	1.03±.15	2.28± .34	
Scapula length	♂	27	49.1– 56.7	53.53±.32	1.64±.22	3.07± .42	2.73
	♀	22	49.7– 53.7	52.09±.23	1.05±.16	2.03± .31	
Humerus length	♂	27	69.7– 79.0	73.84±.34	1.77±.24	2.40± .33	2.99
	♀	23	68.7– 75.0	71.67±.36	1.72±.25	2.40± .35	
Humerus shaft	♂	27	6.0– 6.9	6.48±.04	.21±.03	3.26± .44	3.49
	♀	23	5.8– 6.5	6.26±.04	.20±.03	3.12± .46	
Ulna length	♂	27	87.2–100.3	93.27±.50	2.61±.36	2.80± .38	3.21
	♀	23	85.7– 94.6	90.32±.48	2.29±.34	2.54± .37	
Radius length	♂	27	80.9– 91.9	85.92±.43	2.25±.31	2.62± .36	3.12
	♀	22	78.8– 87.5	83.29±.45	2.11±.32	2.53± .38	
Metacarpal III	♂	27	52.3– 58.9	55.52±.30	1.54±.21	2.77± .38	3.24
	♀	23	51.6– 56.2	53.75±.28	1.33±.20	2.48± .37	
Metacarpal II	♂	27	47.6– 53.6	50.73±.28	1.48±.20	2.91± .40	2.66
	♀	23	47.3– 51.7	49.40±.27	1.27±.19	2.57± .38	
Index, Phalanx 1	♂	27	23.7– 28.2	26.02±.20	1.01±.14	3.89± .53	3.27
	♀	23	23.1– 26.9	25.18±.20	.95±.14	3.77± .56	

Measurement	Sex	N	R	M	σ	V	CD
Index, Phalanx 2	♂	27	14.6– 18.0	16.13±.15	.75±.10	4.67± .64	3.39
	♀	23	14.0– 16.8	15.59±.14	.69±.10	4.39± .65	
Synsacrum length	♂	25	40.5– 47.8	44.33±.36	1.80±.25	4.05± .57	.51
	♀	22	39.9– 47.1	44.11±.38	1.77±.27	4.01± .61	
Mid-synsacrum width	♂	25	29.3– 35.5	33.51±.23	1.17±.17	3.49± .49	1.48
	♀	22	31.3– 35.4	33.02±.23	1.08±.16	3.28± .49	
Postilium width	♂	25	29.2– 36.0	33.68±.30	1.49±.21	4.42± .63	1.34
	♀	22	30.4– 35.9	33.23±.31	1.44±.22	4.34± .65	
Pelvic width	♂	25	21.9– 26.6	24.64±.20	.99±.14	4.01± .57	3.07
	♀	23	21.9– 26.1	23.90±.23	1.11±.16	4.65± .69	
Femur length	♂	27	49.3– 57.9	54.75±.30	1.54±.21	2.80± .38	3.32
	♀	23	50.6– 55.0	52.96±.21	1.01±.15	1.91± .28	
Femur shaft	♂	27	4.4– 5.0	4.60±.03	.16±.02	3.54± .48	2.29
	♀	23	4.2– 4.8	4.50±.03	.14±.02	3.18± .47	
Tibia length	♂	27	87.8–101.7	96.09±.60	3.13±.43	3.25± .44	3.08
	♀	23	87.4– 99.0	93.18±.52	2.49±.37	2.67± .39	
Tibia shaft	♂	27	4.1– 4.9	4.49±.05	.24±.03	5.32± .72	1.91
	♀	23	4.0– 4.9	4.40±.05	.25±.04	5.63± .83	
Tarsus length	♂	27	55.1– 65.3	60.86±.39	2.02±.28	3.32± .45	2.71
	♀	23	56.4– 61.9	59.23±.30	1.41±.21	2.39± .35	
Pygostyle length	♂	25	20.5– 25.1	22.82±.20	1.00±.14	4.38± .62	4.88
	♀	21	20.4– 24.4	21.73±.19	.88±.14	4.04± .62	
Hallux, Phalanx 1	♂	27	20.6– 23.7	22.40±.15	.76±.10	3.40± .46	5.49
	♀	22	19.2– 23.1	21.20±.20	.92±.14	4.33± .65	
Hallux, Ungual Phalanx	♂	26	16.2– 18.5	17.47±.18	.93±.13	5.34± .74	4.97
	♀	22	15.4– 18.3	16.62±.19	.87±.13	5.25± .79	

Basihyal length.—Length of basihyal, excluding cartilaginous processes.

Keel length.—From carinal apex to posterior border of metasternum.

Keel depth.—From dorsal base of manubrium to apex of carina (dividers).

Mid-sternum width.—Least distance between outer margins of each side of sternum at points just posterior to costal margins.

Clavicle length.—Length of one side of furcula; from ventral side of hypocleidium to apex of anterodorsal angle of epicleidium.

Coracoid length.—From head to tip of sterno-coracoidal process.

Scapula length.—From anterior tip of coracoid process to tip of blade.

Humerus length.—From head to most distal point of entepicondyle.

Humerus shaft.—Minimum transverse shaft diameter.

Ulna length.—From proximal point of olecranon process to distal point of external condyle.

Metacarpal II.—From most proximal point of carpometacarpus to facet for articulation of Digit II.

Radius length; metacarpal III; index digit, phalanges 1 and 2.—Greatest length of these elements.

Synsacrum length.—From middle of centrum of first vertebra incorporated into synsacrum to posterior surface of centrum of hindmost vertebra of synsacrum.

Mid-synsacrum width.—Distance between most lateral points of antitrochanters of each side.

Post-ilium width.—Width of postacetabular pelvis; distance between projections overhanging posterior edge of ilio-ischiatic foramina of each side.

Pelvic width.—From posterolateral angle of renal depression of one side of pelvis to corresponding point on opposite side.

Femur length.—From trochanter to distal point of external condyle.

Tibia length.—From proximal point of inner cnemial crest to distal point of internal condyle of tibiotarsus.

Femur shaft; tibia shaft.—Minimum transverse shaft diameter.

Tarsus length; pygostyle length; hallux, phalanx 1 and ungual phalanx.—Greatest length of these elements.

VARIATION IN THE SKELETON

The statistical constants of skeletal measurements are presented in table 3. Variability ranges from 2.16 to 5.54 in males and from 1.63 to 7.11 in females, with average V's of 3.50 and 3.37, respectively. However, in neither sex do the means and modes of the V's coincide. The modes fall in the class with values from 2.5 to 3.0, and hence below the means.

No statistically significant difference was found on comparing V's of the sexes for each character. The closest approach to significance was in length of cranium ($t = 2.07$). Thus, in no skeletal measurement was one sex more variable than the other.

Means of males are greater in every instance than those of females. Overlap in extremes between the sexes for each skeletal measurement obtains; hence, no absolute measurements can be utilized to effect separation of the sexes. Divergence coefficients range from 0.51 to 5.49, and average 3.18 per cent. The modal class of CD's is that with values from 2.5-3.5 per cent. To provide an approximate index of sexual divergence in the skeleton, it may then be said that the skeleton of male *cryptoleucus* is about 3.0 per cent larger than that of females. Significance of difference between males and females in the means of any given measurement has been demonstrated for all except the following, which have extreme t-values of 0.04 to 1.41: cranial depth; mid-sternum width; index finger, phalanx *2*; synsacrum length; mid-synsacrum width; post-ilium width; pelvic width; femur shaft and tibia shaft.

VARIATION IN SCLEROTIC RING

Intact sclerotic rings were preserved with thirty-eight of the skeletons examined. Variation in these rings was studied to the extent of counting the plates comprising them. Nothing was done with variation in the ring pattern. The results summarized in table 4 represent counts on 30 pairs of rings and eight single rings. In only two individuals was there a difference between right and left eye rings in number of plates. Thus, one specimen (male) had rings of 12 and 14 plates, another (female) had 13 and 14 plates.

Table 4

Variation in Number of Plates in the Sclerotic Ring

Number of sclerotic plates	Males	Females
12	1	1
13	5	3
14	23	30
15	4	1

The modal number of sclerotic plates was 14, with extremes of 12 and 15. This agrees with the findings of Curtis and Miller (1938) in nine species of corvids, except that their extreme counts varied only from 13 to 15.

DISCUSSION

A comparison of relative amounts of variability in external and skeletal characters reveals that the average variability coefficient of the latter slightly exceeds that of the former (by approximately one-half of one per cent). However, it should be recognized

that the average of only four external measurements is compared with that of thirty-six of the skeleton, so the small difference is probably negligible.

In three of the four pelvic measurements (synsacrum length, mid-synsacrum width, and postilium width), the coefficients of divergence for the sexes are all less than 1.5 per cent. In the majority (23 out of 36) of the skeletal measurements, sexual divergence in size favors the males by 3 per cent or more. This indicates that the female pelvis is

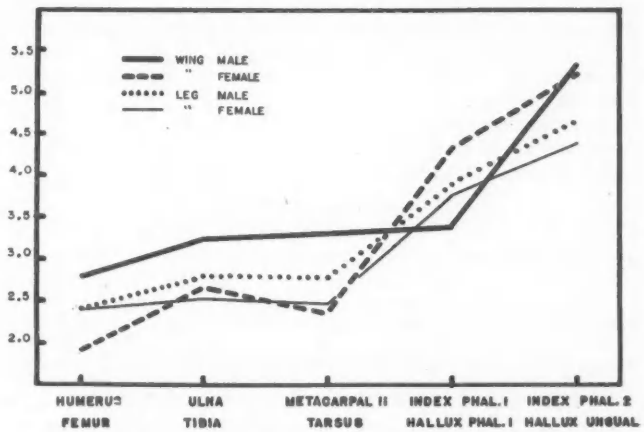

Fig. 1. Coefficient of variability of successively more distal elements of the limbs.

relatively larger than that of the male. Perhaps this is an adaptation to accommodate egg-laying.

Examination of variability existing in the wing and leg skeletal elements of *C. cryptoleucus* brings an interesting picture to light. In figure 1, the V's are plotted for each of the limb elements, which are arranged in order from most proximal to most distal. A trend is evident, with least variation in the proximal elements and greatest in the terminal ones. The gradation is slight, but it is striking that a similar condition prevails for both appendages.

It is noteworthy that other passerine species as well as species of three other orders of birds reveal this same increased variability of distal elements. This is brought out by Fisher's data (1947) on condors (*Gymnogyps*), Goodge's data (1951) on the Common Murre (*Uria aalge*), and Engels' data (1938; 1940) on the American Coot (*Fulica americana*) and the Mimidae. Engels (1940) thinks that in either reduction or lengthening of the wing skeleton, the chief parts involved are the distal ones. This hypothesis is supported by the greater variability of the distal elements in both the wing and the leg of *cryptoleucus*.

SUMMARY

Thirty-six measurements on each skeleton of 27 males and 23 females of *Corvus cryptoleucus* were taken. Standard statistical constants were calculated for these data, as well as for a series of external measurements and weights.

Variability of external measurements was about 3 per cent. Tail length was most variable and extent of wings least variable.

Average skeletal variability was about 3.5 per cent. The skull was somewhat less variable than any other part of the skeleton.

Greater variability was demonstrated in body weight (V about 8) than in any linear external or internal measurement.

A count of the sclerotic plates of the eye ring revealed that the modal number was 14, in agreement with that in other corvids.

In none of the characters considered was either sex significantly more variable than the other. Mean values of the males were significantly larger than those of females for weight, external measurements, and all but nine skeletal measurements. Sexual divergence was about 3 per cent for the skeletal and external characters, and approximately 8 per cent for weight; however, no absolute measurement was discovered by use of which sexes could be distinguished.

A relatively larger pelvis was indicated for females than for males.

In both the fore and hind limb skeletons there was noted a gradation in variability from least in the proximal elements to greatest in the distal elements.

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SOME EXPERIENCES IN IMPRINTING DUCKLINGS

By MARGARET MORSE NICE

The rapid learning of the characters of the parent, which occurs during the first hours of life in some precocial birds, has been called imprinting (*Prägung*) by Lorenz (1935:163*ff*; 1937). He quotes Heinroth's (1911) statement that the newly-hatched Grey Goose (*Anser anser*) adopts as its parent the first living being it sets eyes upon, but that incubator-hatched ducklings flee at their first sight of man. Lorenz (1949) describes this phenomenon with the Grey Goose. He succeeded in imprinting a brood of Mallards (*Anas platyrhynchos*) by constantly quacking (1935:180) and led them by crawling on all fours (1952:42).

The detailed, carefully controlled experiments of Fabricius (1951*a*, 1951*b*) showed that ducklings could be imprinted much more simply than Lorenz believed. He imprinted Tufted Ducks (*Aythya fuligula*) to older ducklings of Shovellers (*Anas clypeata*) and Eider Ducks (*Somateria mollissima*). He also imprinted all three species to himself, either by sitting silently and stretching out his hand toward them or moving away from them, or, with Tufted Ducks, by simply saying *kom kom kom* while invisible to them. Newly-hatched Mallards followed him in response to this call (1951*b*:376-377). "Though rhythmically somewhat resembling the call of the female mallard, conducting its young, my call was by no means an exact imitation of a mallard's quacking." "Monosyllabic verbs other than 'kom,' when uttered in rapid succession, also released the action" in Tufted Ducks.

In 1951 my daughter Constance and I spent June at the Delta Waterfowl Research Station at Delta, Manitoba, watching the behavior of eight species of ducks and of other precocial birds for the first hours after hatching. Fabricius' papers were not then available to us. We took pipped eggs from the incubator, put them into a duck nest in a basin on a table, and watched. The first living beings that the birds saw were us and various precocial birds—ducklings a few hours old, Coots (*Fulica americana*), and Franklin Gulls (*Larus franklini*) a few hours to a few days old. Sometimes I held a duckling in one hand while I sketched it. We kept the hatchlings in the warm incubator room from two to eight hours, then returned them to the hatching tray. The next morning they showed no special bond to us, nor to the Coots (smaller than they), nor to the gulls (of about the same size). One of these ducklings, a Mallard of 6½ hours, followed us for six feet; we did not test it later, nor did we test any of the others. Our first subjects were Pintails (*Anas acuta*) and they seemed to be partially imprinted on us; we watched them for eight hours the first day they were moved into a brooder and two hours the next, but with no good results for them, for they spent their energies trying to jump out to us instead of settling down to the business of learning to eat. So we kept away: they forgot us and throve.

I asked Dr. Fabricius why our birds had not become imprinted to us. He suggested that we had not released their following reaction by calling and walking slowly away from them and that we had not conducted them. In June of 1952, I was again at Delta and made definite efforts to imprint the ducklings which I watched. I am greatly indebted to Eric Fabricius for his invaluable advice, and to Albert Hochbaum, Director of the Delta Waterfowl Research Station, and to Peter Ward, Superintendent of the Hatchery, for the opportunity to prosecute the study and for their generous assistance in every detail.

THE EXPERIMENTS

Six Shovellers hatched on June 11, 1952. At 3 p.m. I took two ducklings, A and B, from the incubator; they were dry, but not yet standing on their feet; I estimated their ages as between 6 and 10

hours. I put them in the duck nest in a basin and covered them with my hand. I said *kom kom kom* many times, then slowly withdrew my hand, but they remained motionless. After seven minutes they started climbing out of the nest, *coming straight towards me.* I cuddled them in my hand. I then took them out of doors and slowly walked away, calling *kom kom kom. They scrambled after me.* I marked them and returned them to the hatching tray.

I took two pipped eggs out of the incubator. C hatched at 4:29. It kept its eyes shut for most of the first hour as it burrowed in the down of the nest. At 5:34 it rose on its tarsi, opened its eyes and stretched its mandibles. I said *kom kom kom.* It said *wheat wheat wheat* and gave a little bow in greeting. I covered it with my hand and it gave conversational notes. It preened and moved about, giving contented notes, while I answered with *kom kom kom.* At 5:45 it stood up and greeted me. At 7:25 it stood up and "cried," *i.e.* gave the distress call, but was quiet when I said *kom kom kom.* At 7:29 *it crept towards me.*

D hatched at 6:03. At 7:33 it cried, but stopped when I said *kom kom kom.* It then *tried to crawl towards me.*

The Redhead (*Aythya americana*) hatched in the incubator the same day. I took it out that afternoon several times, put it in the nest and said *kom kom kom* to it, but did not try to get it to come to me.

On June 12, at 7:30 a.m., I took out the four imprinted Shovellers (A-D), and two others (E and F) that had hatched in the night, and put them in the nest. B and D cried, but stopped at *kom kom kom.* All nibbled my fingers and my arm. I returned them to the hatching tray.

At 9:30 I found that these six and the Redhead had been moved into a brooder out in the brooder room. All came toward me instead of hurrying in the opposite direction as did all the other sets of ducklings. All gave conversational notes, the Shovellers bowing in greeting. A six-day-old Shoveller, T, had been added to the group as a teacher to start them off eating and drinking. It seemed a little nervous, but stayed with the imprinted ducklings.

On June 12, at 1:43 p.m., the Mallard hatched in the same duck nest and proved vigorous and lively. At 1:46 I said *kom kom kom* and held my hand over it; it nibbled my fingers. At 1:52 it called, but stopped when I said *kom kom kom.* It burrowed under my hand. At 4:43 I put it on the shelf; *it crawled to me with conversational notes* and nibbled my fingers. I watched it all afternoon, but did not try to get it to follow. The next morning I had it out on the shelf for a while, marked it and returned it to the tray.

On June 13, at 6 a.m., all the Shovellers came to my call; all bowed and talked; all ate out of my hand, as did the Redhead. I took C and D, put them on the floor and backed away, saying *kom kom kom*; they paddled after me. Then I took out F and the Redhead; they cried a little bit, but followed at my heels. I took out A alone and he hurried after me.

The following morning at five, I went into the brooder room and as an experiment said *kom kom kom* to a brooder into which a set of new ducklings had been put the previous evening; out from under the curtain came one duckling. I picked it up and found it was the Mallard. I had not seen it since early on the 13th, although it had probably seen me as I opened the incubator door as I worked with Coots. I took it on a little walk and it followed closely, crying loudly when I returned it to the brooder. Ten minutes later it was still crying. I came quietly to the brooder; it at once changed to the conversational notes, peeping contentedly. I took it up and cuddled it, then hurried away, followed by loud cries of distress.

At 11:00 several of us took the Shovellers, Redhead, and Mallard into the laboratory. The whole set came running to Margaret Hickey's *kom kom kom* and followed her when she moved. They followed the men just as readily, but did not respond to their *kom kom kom.* The Mallard was always in the lead, followed by the small Shovellers in single file, then the Redhead, and finally the older Shoveller. We put the Mallard in a pail and it cried loudly, but the others paid no attention. They followed us just as well without the Mallard, so they had not been following it, but us. I put the Mallard into the brooder with the Shovellers and Redhead and it appeared content.

On June 15 the group again followed two of us closely, the Mallard in the lead, as before. When we sat down, they settled down near our feet. On the 17th I took out two of the Shovellers and they behaved as before. They showed no anxiety for the rest of the group, as did Lorenz's (1935:374) brood of Mallards. On the next day the birds were put into a large pen with a chance to swim. I

called them; the Shovellers bowed and bowed while the Mallard and Redhead seemed a little less confident. I took two Shovellers into the laboratory; they followed us as usual. On the 22nd I called *kom kom kom* and all of the birds came out of the brooder, the Shovellers bowing. I took two out and conducted them up the hill and back; they were excited to be outdoors and were a little difficult to catch on our return. The next day I took out three and conducted them with three Gadwalls. This was the last day I took them out. On July 1 I called *kom kom kom* to them, but received no response.

On June 19 I watched three Gadwalls (*Anas strepera*) hatch from 2:32 to 3:05 p.m., saying *kom kom kom* to them and cuddling them in my hand. At 5:10 *all scrambled out of the nest in my direction*. In the evening I took them out of the incubator and again said *kom kom kom*. In contrast with all the other ducklings we had watched, I kept these three with my group of coots and gulls. The next day at 2:30 the ducklings were very restless, as if ready to follow their mother from the nest. I took them and the coots and gulls outdoors and all followed at my heels. At 4:30 they were again restless and I took them on a walk of over 100 yards; on our return they settled down contentedly to eat, drink, and rest. From the 21st to 26th they followed me well, but after that they had no opportunity until July 1st and 4th, on neither of which dates did they respond to my calls nor to my walking away from them.

Of two Wood Ducks (*Aix sponsa*), A hatched on June 20 at 8:15 p.m. As it was alone in the nest, I held it in my hand a good deal, saying *kom kom kom* at intervals. At 8:55 it tried to climb out to me; at 9:05 it tried to jump out and again at 9:45 and 10:11. At 10:20 it succeeded and went to sleep in my hand. B hatched at 10:01 and spent its first hour sleeping. I made no attempt to imprint it and left the hatchery at 11:00, leaving both ducklings in the incubator. The next morning A came straight to me, while B retreated. I put both in the duck nest where B settled down beside a gull, but A came right out to me, twittered to me, climbed onto my arm and into my hand. I tried to get it to eat, but with small success. It followed me with the Gadwalls early in the afternoon. By 4:30 it was so determined to jump out to me that I took all the birds on a longer walk. The next day it followed me up the hill and back trailing after the Shovellers, but in the hatchery its one aim was to get to me, so I put it in the brooder in the brooder room with B and other new ducklings. It would not eat, however, and did not survive.

DISCUSSION

The experiences with the 12 recently-hatched ducklings are summarized in table 1. Seven of them were watched as they hatched, while the others were first seen when dry, perhaps five to ten hours old. Thus, they all fell within the most favorable period for imprinting—the first 12 hours (Fabricius, 1951*a*:65). All were exposed to acoustic signals and nine were deliberately stimulated by the moving of my hand. Shovellers A and B came toward me seven minutes after the experiment started. The seven that hatched under my eyes came to me as soon as they could crawl—from the age of 1½ to 3 hours.

Fabricius (1951*a*:163) found a combination of visual and acoustics signals the most effective means of imprinting the ducklings; "the releasing effect was enhanced when they interacted by *heterogeneous summation* (Tinbergen, *op. cit.*)." He experimented with visual signals alone, sitting in silence before his subjects, moving his hand away from them, then walking away; three Tufted Ducks aged 4 to 6 hours, two eiders of 6 to 12 hours and five Shovellers of like age all followed him. He also imprinted three Tufted Ducks 24 to 48 hours old by saying *kom kom kom* while invisible to them (1951*a*:36). (In his later paper he speaks of these as "new-born" (1951*b*:377) but he writes me that he used this word in the sense of "inexperienced.") He concludes that "*At least in the tufted duck, the shoveller, and the mallard, the acoustic stimuli seemed to have a stronger releasing effect than the optical ones*" (1951*a*:163).

In 1951 several Pintails and one Mallard studied by me seem to have been imprinted with visual stimuli only. In 1952 nine of the ducklings were deliberately imprinted with acoustic and visual signals, the other three incidentally with acoustic signals. None of the three came to me until 5 to 14 hours after first exposure to a human being, but F and the Redhead followed me on their first test with no example from companions.

Why did the six-day-old Shoveller T follow us? When first seen by me it was long past the age for imprinting, yet it followed after the other ducklings, always at the end of the procession. It must have been "tame" to begin with and the bond to the other birds was strong enough to carry it along with them, a matter of social contagion.

Social contagion had no influence in one of Fabricius' experiments (1951*a*:72) with five Tufted Ducks a few hours after their imprinting, and in two that had accepted no parent-companion. Of these, four were imprinted on an eider, and one ("43") on himself. He put the ducklings together in a cage and all swam close together until the eider was introduced into the neighboring cage, whereupon its four "children" swam to it. It was removed and Fabricius showed himself; "43" at once swam to him, while all the others tried to escape.

Table 1

Imprinting of Twelve Ducklings at Delta in 1952

Duckling	Age when first seen	I moved hand away	Age when it came to me	Age when first conducted
Shoveller A	6-10 hrs.?	x	6-10 hrs.?	6-10 hrs.?
B	6-10?	x	6-10?	6-10?
C	Hatching	x	3	37
D	Hatching	x	1½	35
E	7?		12?	60?
F	7?		12?	30?
Redhead	5?		20?	40?
Mallard	Hatching	x	3	39
Gadwall A	Hatching	x	2½	24
B	Hatching	x	2	24
C	Hatching	x	2	24
Wood Duck A	Hatching	x	2	18

With Fabricius' birds there was no personal recognition of the care-taker so far as optical stimuli were concerned, but no one could successfully imitate his *kom kom kom*. Our birds followed any man or woman—our costumes were much alike—who moved away from them. As to *kom kom kom*, they responded to Mrs. Hickey's version as well as to mine, but not to that of any man.

The Shovellers followed us until 12 days of age, the Gadwalls until 7 days. At this time five days elapsed without observation, and when I later tried to induce the birds to follow me by calling or by moving away from them, they failed to respond. The fact that they saw people all day long who did nothing to release following-reactions might well have nullified the early conditioning to regard human being as parent-companions.

Fabricius spent far more time with his ducklings that did I with mine; he cared for them entirely himself and conducted them every day on land and in water. Also, many of his birds were lost through a storm and it is natural that the few survivors would be more attached to their parent than were my ducklings that were surrounded with avian companions. He first noticed a decrease in the following reaction "in the eiders at 26, in the tufted ducks at 20, and in the shovellers at 23 days of age" (1951*a*:165). Tufted Duck "43" and an eider were given to a zoo at the ages of 4 and 7½ weeks, respectively. When Fabricius visited them 2½ weeks later and again 5 weeks after this, and called *kom kom kom*, both birds greeted him emphatically and tried to follow him (1951*a*:82). In 1952 the conditions of his experiments in imprinting to models were somewhat similar to mine. He writes me: "if our ducklings were not allowed to follow the model for at least about 15 minutes every day, they very soon 'forgot' the following."

When I wrote to Dr. Fabricius about imprinting ducklings I said I doubted whether

I should attempt it since I would not be able to care for them myself as he had done. He answered: "I think there is no danger in making ducklings imprinted, for if there are many sisters together, they will begin to eat and grow up very well even if the 'parent-companion' is absent." This was clear from his experiments in 1951 with imprinting ducklings to models. The one unfortunate experience in my imprinting in 1952 was with the Wood Duck. If I had kept both birds in my flock, or if I had put A right away in the brooder with B and other ducklings their age, although not their species, it is possible A might have survived. Wood Ducks hatched in captivity are often difficult to get started unless there is a good number of them. This species has a lonely call, differing from that of any other duckling I have heard; it is a kind of twitter. A was hatched alone and remained alone two hours; then B hatched, but B merely slept and scarcely functioned as a companion. The next morning A showed little interest in the two-day-old Gadwalls or in the small coots and gulls, and the following day there seemed no bond at all. It had a fixation on me; it would not eat and died when three days old.

The Mallard was left in the hatching tray longer than usual—some 30 hours—before it was transfered to a brooder with other small ducklings. It probably would have adjusted here successfully if I had not happened by early the next morning with *kom kom kom*; it might well have done so if left alone after that. At any rate, the experience at 11:00 with the Shovellers and Redhead was sufficient to form a bond with these ducklings so there was no more crying after the parent-companion.

My attempts at imprinting were incidental to my general study of behavior of newly hatched precocial birds and are in no sense an investigation of the underlying factors, as are Fabricius' intensive studies. The aim of this paper has been to show the ease with which imprinting can be achieved in ducklings with Fabricius' simple technique and also to point out some of its dangers. In most behavior studies it is an advantage to have one's subjects tame rather than wild. Yet imprinting involves a serious responsibility, if there is not a group of young birds to offer companionship to one another. Also, if ducks are being raised for later release, they should not become attached to people.

SUMMARY

In studies of newly-hatched ducklings in 1951 almost no imprinting occurred. In 1952, by using Fabricius' simple technique, 12 ducklings of five species were imprinted on human beings as their parent-companions at hatching or shortly after hatching through acoustic signals (the call of *kom kom kom*) and through visual signals (movement of the hand or of the whole person away from the subject).

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Chicago, Illinois, August 22, 1952.

NOTES ON THE BIRDS OF DAIKOKUJIMA, HOKKAIDO, JAPAN

By CHESTER M. FENNELL

On June 20 and 21, 1951, while visiting the town of Akkeshi on the southeastern coast of Hokkaido, Japan, I spent a night and portions of two days on the island of Daikoku, which lies directly across the entrance of Akkeshi Bay and approximately two miles from the nearest point of the mainland. Daikokujima extends in a southwest-northeasterly direction and is approximately one and one-half miles long by one-quarter mile wide. Its coastline rises sheer from the water's surface on nearly all sides. Most of the island is roughly three hundred feet in elevation, rolling in contour, and deeply intersected by two main valleys which neatly cut the land mass into nearly equal thirds. These valleys are choked with medium-sized pines (*Pinus densiflora*), small birch trees, and other low, mixed deciduous growth. The summit slopes are covered with grass, *Artemisia vulgaris*, and *Petasites japonica*. Approximately one-tenth of the top of the island is under cultivation and provides several kinds of vegetables for the few inhabitants.

The extreme northeastern tip of Daikokujima is characterized by a low, narrow, sandy point of beach which provides the only suitable landing place for a boat and supports ten or twelve Japanese fishermen's huts.

The following observations were made during my visit.

Oceanodroma leucorhoa leucorhoa. Leach Petrel. It was impossible to estimate the total population of this species on the island during the short period of my visit, although I had no doubt that it ran into several thousand individuals. The entire top of the island, except for the cultivated areas, seemed to be riddled with its nesting burrows, and if one left the beaten trail, it was almost impossible to avoid caving into burrows at every other step. The soil in general is a dark, rich loam and is easily worked by the petrels. Apparently they prefer to burrow in among the root systems of patches of *Artemisia* and along the extreme edges of the grass-overgrown tops of the sheer cliffs. I found them particularly numerous along the banks of the trails. The burrows measured from 45.0 to 53.5 cm. in depth, sharply descending into the ground for the first eight or ten centimeters, then leveling off more gradually toward the end. In nearly all the burrows there was a sharp turn to the right or left within some 20 centimeters of the entrance. The entrances averaged 8.5 centimeters in width and 7.0 centimeters in height.

Of approximately 25 burrows examined, all but one contained single birds each on one egg. The exception contained a bird but no egg. In all cases the floor of the end of the burrow was lined with short pieces of dry weed leaves, stems, and moss. Of ten eggs collected, five were fresh, three slightly developed, and two approximately half developed.

Of a total of eight birds collected in burrows on eggs, four were males and four females. All were collected in broad daylight, at approximately 3:00 p.m. Nearly all birds uttered a mellow, squealing sound when pulled from the burrow and gently pecked the fingers holding them. Nearly all disgorged an oily, orange-yellow liquid upon being removed from the burrow. When released from the hand, they usually fluttered for a short distance and then blindly flopped to the ground among the weeds and grass. Others, when tossed into the air, flew low over the ground and disappeared down the slopes. One, upon being thrown into the air, flew low in short, rapid circles around the immediate area some five or six times and finally crashed into a clump of *Artemisia* and fell out of sight in the vegetation.

I revisited the nesting area at 9:00 p.m., just as darkness was settling, and found several birds in low flight over the ground. Several birds in the burrows, in close colonies, were uttering soft, mellow, purring calls, which ascended in pitch and terminated in a high squeal and a sharp *keck* note. This call was given repeatedly for periods of five to ten minutes or more, suddenly halting all at one time and followed by absolute silence. This particular call was inaudible at a distance of more than eight or 10 feet.

Another call heard was apparently given by single birds just within the entrances of their bur-

rows, situated some 20 or 30 feet apart. This consisted of a loud, burbling, gurgling, musical "song" given every half minute or so.

All calling and flight activity seemed to continue at a fairly high rate during the entire hour and a half I remained in the vicinity. The fall of complete darkness at 9:30 p.m. and the rise of a bright full moon fifteen minutes later seemed not to affect the degree of activity in the slightest.

Bloody remains of wings and feathers of the petrels were observed along the edges of the steep cliffs and strengthened my opinion that this species formed the main diet of the Hobby (*Falco subbuteo*), a pair of which was observed from time to time on the island. No other bird of prey was seen on the island, and although I failed to see a Hobby in the act of capturing or devouring a petrel, the evidence indicated that they did.

According to Kyogo Yamamoto, my guide and long a resident of the town of Akkeshi, the Leach Petrel arrives on Daikokujima around April 20 each year and remains until the latter part of October.

Phalacrocorax capillatus. Temminck Cormorant. Eleven birds were observed on June 19 in flight and resting on the water along the shore of Akkeshi Bay, while a group of 15 others were seen clinging to steep, excrement-whitened cliffs on a rocky headland, locally called Aikappu, at the entrance to Akkeshi Bay. A group of 25 more was observed resting on a water-surrounded rock near another rocky point known as Aininkappu, approximately one-quarter of a mile farther out toward the open sea. This group was in company with a large flock of Slaty-backed Gulls (*Larus schistasagus*) and Pelagic Cormorants (*P. pelagicus*). Two immature birds were collected. On the following day five were seen while going to Daikokujima from Akkeshi.

Upon reaching the island, I saw ten perched on the top of a high, water-surrounded rock at the extreme southwestern end of the island at the foot of the cliffs near the lighthouse. Kyogo Yamamoto expressed the belief that this rock was a nesting site, although with field glasses I was unable to see any nests or brooding birds. A long bamboo ladder placed against the rock and reaching toward the top indicated that the site had been disturbed by the egging activities of the local fishermen. Inquiries among the fishermen produced a gift of ten cormorant eggs, all of which they claimed to have collected from the top of a large rock off the southeastern side of the island. The majority of these contained nearly fully developed embryos and I was able to save only three eggs. Two of these were slightly more than half developed, while the third was in fresh condition.

From the high cliffs of the southeastern coast we were able to look directly down on a large rock approximately 200 feet off shore and through the field glasses plainly saw a total of some 25 cormorant nests all covered by brooding birds. A group of approximately fifteen birds was perched on the topmost portion of the rock. Among these some appeared to be immature birds with whitish underparts. All birds on the nests appeared to be in full adult breeding plumage, with no trace of white on the throat or breast.

At low tide on the following day, I climbed a small promontory at the base of the cliffs directly opposite the breeding rock to observe the colony more closely. The nesting rock was approximately 100 feet high and was cut off from the main island by a narrow but fairly deep channel of water. It was composed of a loose, crumbling conglomerate roughly and irregularly eroded into shelves and hollows which provided foundations for the nests. A scanty growth of green grass and small plants clung to the sides of the rock facing the shore. The topmost portion was devoid of vegetation and seemed well trodden by the resting birds. The lower half of the rock was worn away by the wave action and the top overhung the base so that the nests were inaccessible without the aid of ropes or a ladder. The nests appeared to be constructed of a brownish, straw-like material and for the most part occupied the uppermost third of the rock. The lowest nest was situated under a protecting shelf of rock approximately 50 feet above the water. All brooding birds seemed to be affected by the bright sunshine and, although the air temperature seemed cool and comfortable to me, they kept up a rapid vibration of their gular pouches. Six nests of the Slaty-backed Gull were also noted on the rock, all attended by brooding birds. One gull nest was located within three feet of a cormorant's nest. No friction or attempted robbery of nests was observed between the two species in the course of the entire period of my observation.

Upon the close approach of a small fishing boat, a total of 75 cormorants left the rock and circled out over the water in squawking protest. Nearly all the brooding birds left their nests at this time, while a group of 25 idlers remained on the top of the rock and declined to take flight. I felt that these counts fairly established the total population of the colony at about 100 birds.

After the departure of the boat, one bird was observed to pick up a stick from one of the nests, fly out over the water in a wide circle, and return to the rock where it continued to hold the stick for nearly a minute before finally allowing it to drop carelessly and aimlessly from its bill. This was probably a displacement gesture prompted by the presence of the boat, since I witnessed no other signs of nest construction during the entire visit.

Phalacrocorax pelagicus. Pelagic Cormorant. Twelve were observed on June 19 resting on a large rock near Aininkappu in company with a flock of Slaty-backed Gulls and Temminck Cormorants. On June 21 a single bird was observed swimming in the water at the base of the nesting rock of the Temminck Cormorants off the southeastern coast of Daikokujima. No sign of a nesting colony was seen nor did any of the residents of Akkeshi or Daikokujima with whom we conversed seem to have any knowledge of the species breeding in the immediate vicinity.

Falco subbuteo. Hobby. Two were observed on June 20 on Daikokujima. One was in flight along the top of the steep cliffs at the extreme southwestern end of the island, standing against the strong wind in company with a large flock of Slaty-backed Gulls. The second bird was seen late in the afternoon quietly perched on a spur of the sheer, grass-topped cliffs along the southeastern edge of the island. It remained motionless during the period of observation except for a side to side movement of the head. No sign of its breeding was noted although it may possibly nest in the vertical rock cliffs facing the sea. The huge population of Leach Petrels apparently provides the pair with a virtually unlimited source of food.

Capella hardwickii. Latham Snipe. Based upon the frequency of nuptial performances heard on the evening of June 20, I estimated the population of this species on Daikokujima to range between 75 and 100 individuals. All were observed in flight over the open grass- and weed-covered summit slopes, with the greatest concentration apparently inhabiting the more level expanses at the extreme northeastern portion of the island. This was the area most heavily populated by the Leach Petrel.

The peak of the aerial performance seemed to be attained at dusk, around 9:00 p.m., and gradually decreased in intensity as darkness closed in. Silence came with the fall of total darkness, at 9:30 p.m. Activity was renewed with the rising of a full moon some fifteen minutes later and gradually increased to the previous degree of intensity, which was maintained until I left the field of observation at 10:30 p.m.

The performance consisted of a circular flight, some 25 to 30 feet above the ground, accompanied by a rather harsh *zrack, zrack, zrack* note uttered quite regularly and interrupted only by the rapid *gă, gă, gă, gă, gă, gă, gă, gă, gă, gă* accompanying the frequent power dives. The latter call has a rather weird, feathery quality and increases in both tempo and volume as the bird nears the ground. A halting sort of choke interrupts the series of notes some three or four syllables before the end, adding to the feeling of rush and stumbling haste. None of the performers appeared actually to alight on the ground at the end of this dive but seemed to veer off and rise into the air to continue the circling flight. From the great number of performers in the air at the same time, I think that both sexes may possibly participate in this maneuver.

A total of five birds was flushed from the ground in the late afternoon of June 20 and ten in the early morning hours of June 21. The nuptial performance was heard only twice in the daylight hours and occurred at 8:30 a.m. on the 21st. A heavy fog covered the entire island at that time and more or less produced an effect of approaching dusk.

In spite of many crossings and recrossings of the most heavily inhabited area observed the evening before, I was unable to locate a nest. Kyogo Yamamoto claimed to have found nests in that field on approximately the same date in other years, and said that brooding birds would invariably flush from the nest within a couple of feet. Since not a single bird was flushed within such close range, apparently it was still too early for the nesting season. The ovary of a female collected in the area, although somewhat enlarged, did not indicate the height of the egg-laying period. However, Col. L. R. Wolfe, in company with Hyojiro Oii, located several nests with eggs already well developed in the middle of June, 1950, in the vicinity of Uenai near Tomakomai, Iburi Province, Hokkaido, while Sgt. Gordon Burns of Kure reports having found nests with fresh eggs on the lower slopes of Mt. Fuji, at approximately 2600 feet elevation, on May 15, 17, and 19, 1951. It is my belief that the cooling effect of the water surrounding Daikokujima may retard the nesting season of this species in that area.

Larus crassirostris. Black-tailed Gull. A group of approximately 75 was observed on June 20 in company with a flock of some 65 Slaty-backed Gulls resting on the tip of the sand bar at the extreme

northeastern end of Daikokujima. Although they were also seen as stragglers in flight around the piers near the town of Akkeshi, I failed to find any others than those just mentioned and concluded that the species did not breed on Daikokujima. Kyogo Yamamoto confirmed this opinion.

Larus schistasagus. Slaty-backed Gull. I estimated the breeding population of this species on Daikokujima at approximately 500 birds, although it may have been considerably larger. The heaviest concentration of nests appeared to be on high, inaccessible shelves of eroded or grass-covered soil along the tops of the cliffs at the southwestern end of the island. The eggs are highly relished by the residents and by visiting fishermen who undertake great risks to obtain them. In several places I noticed lengths of rope secured to the top of the cliffs and precariously leading down over the side of the loose, crumbling edges of colonies of pilfered nests below. For the single breakfast that my guide and I were served by the fisherman's family with whom we spent the night, we were offered hard-boiled fresh eggs of this species. They proved delicious, the yolk being quite small in comparison to the amount of egg-white.

A single empty nest located on the top of a low, grassy spur of rock and soil along the northeastern coast of the island was constructed wholly of dry grass and weed stems and was placed in a depression in the green grass. It measured 38.0 centimeters across the top from one outside rim to the other, 23.5 centimeters across the top of the incubation bed, and 9.25 centimeters deep inside.

Large numbers of this species also nested on high, rocky cliffs along the headlands of Aikappu and Aininkappu at the entrance to Akkeshi Bay. A large transient population also frequented the waterfront area of the town of Akkeshi, seemingly attracted by the unloading of the fishing boats and the offal of the fish canning factories in the neighborhood.

Cepphus carbo. Sooty Guillemot. A total of 168 was observed resting on the water at the base of the cliffs in the immediate vicinity of Daikokujima. Eighteen of these were seen on June 20 at the southwestern end of the island and the remainder on the following day near the base of the rock on which the Temminck Cormorants nested. Of the latter group, several swam in close among the rocks and kelp along shore. Three birds were observed singly and in low flight as though they had just emerged from nesting crevices among the loose rocks at the base of the cliffs. Definite evidence of nesting was not obtained.

Twenty were observed nesting on the water at the base of Aikappu and 26 were seen in the vicinity of Bara-san, another high, rocky headland close to the town of Akkeshi. In both these latter locations, several were observed flying to and from small niches high up in the face of the sheer rock cliffs in which, I presume, nests were located. Several others were observed in pairs pursuing one another in low, rapid flight over the water as though in courtship play.

Lunda cirrhata. Tufted Puffin. Although I was unable to see a single individual of this species during my stay on Daikokujima, Kyogo Yamamoto showed me a group of approximately ten large burrows located on a small, grassy plateau at the southwestern tip of the island and said that puffins had nested there. The plateau was separated from the top of the island by a very narrow, badly eroded, crumbling ridge of reddish soil and rock and was not safely traversible without the aid of ropes.

Apus pacificus pacificus. Large White-rumped Swift. A single female with an enlarged ovary was taken while in flight over the top of Daikokujima on the afternoon of June 20. Three others were also observed in flight near the same place on the same day. Approximately 200 were constantly in flight around the steep rock cliffs of Bara-san near the town of Akkeshi and were seen to enter and emerge from narrow cracks and fissures in the rock where I supposed them to be nesting. A harsh, metallic *sweer* was voiced while in flight; a sort of musical, chattering twitter was heard from within the recesses of the cliff walls.

Alauda arvensis. Japanese Skylark. One individual was observed on June 20 in an open grassy field on top of Daikokujima.

Corvus levaillantii japonensis. Jungle Crow. Nine of these birds were observed on Daikokujima in the period of my visit. All were found on the sandy point and on rocks at the northeastern end of the island in the immediate vicinity of the fishermen's houses. On the mainland, in the vicinity of Akkeshi, this species far exceeded the Carrion Crow in numbers, but on Daikokujima I found the opposite condition prevailing.

Corvus corone orientalis. Carrion Crow. Twenty-one were observed in the period of my visit The majority were seen on the top of the island in groves of pines and mixed deciduous growth.

Luscinia calliope. Rubythroat. Of the seven individuals observed, nearly all were males in full song which frequented small, brushy, deciduous growth in the small valleys on top of the island bordering the open grass and weed slopes.

Locustella fasciolata. Gray's Grasshopper Warbler. Three were heard singing in groves of small deciduous growth on the top of the island. One in particular was heard singing constantly from 8:45 p.m. until 10:30 p.m. on June 20. The fall of total darkness at 9:30 p.m. did not seem to have any effect on the vigor and frequency of its song. A full moon rose at 9:45 and the singing was still in full force when I left the field at 10:30.

Acrocephalus bistrigiceps. Von Schrenck Reed Warbler. A total of 11 was observed in low deciduous undergrowth and/or were flushed from grass and weed fields on top of the island in the same general areas inhabited by the Leach Petrels. Several were heard in full song. This species apparently nests here although I found no proof of this.

Motacilla alba. Pied Wagtail. Observed singly on twelve occasions on the rocks and sandy strip along the coast near the water's edge. This species presumably breeds here.

Yokohama, Japan, November 10, 1951.

FROM FIELD AND STUDY

Long-eared Owl (*Asio wilsonianus*) at its nest in San Diego County, California. Photograph by Ed Harrison and Frances Roberts.

Sub-nival Feeding of the Redpoll in Interior Alaska: A Possible Adaptation to the Northern Winter.—The Common Redpoll (*Acanthis flammea*) is one of the few species of bird that regularly over-winters in the cold, interior region of Alaska. There are but five other passerine birds that do so in the Fairbanks area—the Raven (*Corvus corax*), the Canada Jay (*Perisoreus canadensis*), the Black-capped Chickadee (*Parus atricapillus*), the Hudsonian Chickadee (*Parus hudsonicus*), and a second fringillid, the Pine Grosbeak (*Pinicola enucleator*). The Hoary Redpoll (*Acanthis hornemanni*) perhaps also over-winters here, as a few specimens have been taken from mixed flocks of the two species in the late winter and early spring, but this fact is difficult to establish from field observations, and all but three specimens out of a series of thirteen from the Fairbanks area seem to be referable to *flammea*. In addition to the above, wintering populations of the White-winged Cross-bill (*Loxia leucoptera*) may, as elsewhere in the North, occur at sporadic intervals, probably correlated with the fluctuation in the abundance of its specialized food, coniferous seeds.

Little is known about how these birds are capable of surviving under sub-arctic winter conditions, which present two major problems to living organisms: (1) an extremely low environmental temperature and (2) a marked scarcity of food. Certainly a complex of physiological, somatic, behavioral, and ecological factors is involved. The excellent series of papers by Scholander, Hock, Walters, Irving, and Johnson (Biol. Bull., 99, 1950:225-271) has opened a way to an understanding of the roles of physiological heat-regulation and body-insulation in the adaptation of arctic animals to cold. On the other hand, the winter problem of food-scarcity has not, to my knowledge, received detailed treatment in the literature, although it is quite generally recognized to exist.

With this latter problem in mind, the following observations on the Common Redpoll are offered to suggest the basis for a more extended view of the many possible ways in which birds come to face the far northern winter.

Near the Fairbanks Country Club, about seven miles outside Fairbanks, there is a grain field, well-sown to weeds, mostly *Chenapodium album*, to which the redpolls commonly resort for food. On the afternoon of December 2, 1950, as I was skiing past this field, a group of seven redpolls, fol-

lowed soon after by another group of twenty-five, flew by and alighted in the field. The sky was overcast; the temperature about zero degrees F. There had been a light snow the night before, with slight continuing flurries throughout most of that day, about three inches of fresh snow having fallen. In the days preceding this new snow there had been some strong winds that caused considerable drifting and crusting of the old snow, conditions unusual for the region. On this day no weeds were visible above the snow in the field, and hence I was puzzled to know how the birds could obtain their food. As I skiied out toward them, I saw that they were, in fact, feeding under the snow!

In many places the snow had drifted out from under the bent-over tops of the weeds, creating tunnels and openings below the surface, which allowed the birds access to seeds that had fallen on the ground previous to the snows. In some instances, also, where the taller plants had formed a sufficient canopy to support the snow-cover, seeds still adhering to the shorter plants were available for foraging in the air-spaces thus created under the snow. At several places the entrances to these sub-nival chambers appeared to have been dug out by the birds themselves, as there were many scratch marks in the snow, although this appearance might have been produced by the frequent exit and entrance of the redpolls into and out of these holes.

Several redpolls were seen to fly out of these burrows as I approached; several were seen actually picking up seeds under the snow before they were flushed out; and two birds refused to leave their shelters until I had stopped by their burrows not more than two feet from them. These observations suggest a possible adaptation to the problem of winter food-scarcity.

On frequent trips to this field during the remainder of the winter no similar activity was observed, and in fact redpolls were not again recorded for the area until March 29, when a flock of fifteen was seen in some alders bordering the field.

Other personal observations indicate that throughout the year in interior Alaska, the redpolls feed primarily upon the seeds of alders (*Alnus*) and birches (*Betula*) in keeping with their arboreal predispositions, but they also feed to a very considerable extent—especially in areas of human occupance—upon the seeds of lamb's quarters, *Chenadodium album*, and to a lesser extent upon some other cruciferous and composite weed seeds. The seeds of these food plants are eaten green (and in the flowering stage) in the spring and summer and in the dried state in the autumn and throughout the winter.

When the winter snows are at their maximum depth, however, most of the *Chenapodium* weeds are completely covered. In addition, the fruit bearing branches of the alders and birches are often heavily laden with snow. Then one must suppose these birds are hard put to find enough to eat. The importance of the snow-cover as a factor limiting the availability of food to birds during the northern winter in Arctic Lapland has been discussed recently by D. W. Snow (Ibis, 94, 1952:133-143), and among the adaptations to the arctic winter listed by him is the "ability to find food under the snow" (*op. cit.*, p. 140). My observation suggests that the Common Redpoll, at least under some circumstances, is so adapted in interior Alaska—or perhaps more correctly put, it has a sufficiently adventuresome disposition to utilize sub-nival situations, despite the fact that it is primarily an arboreal species. Such ecological and behavioral plasticity would seem to be of definite survival value in the far northern winter environment.—Tom J. Cade, *Alaska Cooperative Wildlife Research Unit, College, Alaska, May 15, 1952.*

Bird Notes from Western Montana.—The following records appear to add significant information to that previously published on the birds of western Montana. Items reported are supplementary to Saunders' "A Distributional List of the Birds of Montana" (Pac. Coast Avif. No. 14, 1921) and to subsequent distribution notes appearing in the Auk, Condor and Murrelet.

Aechmophorus occidentalis. Western Grebe. This grebe previously has been reported nesting in Lincoln County and in Glacier Park. It is a common breeder farther south at Ninepipe Migratory Bird Refuge in Lake County, approximately 50 miles north of Missoula. On August 5, 1940, I saw an adult with nine rather large young and on June 11, 1941, two adults were noted, each with a downy chick on its back.

Phalacrocorax auritus. Double-crested Cormorant. Saunders lists this as "a rare migrant" whereas Weydemeyer and Marsh (Condor, 38, 1936:185-198) found this species nesting at Lake Bowdoin in Phillips County in 1932 and 1935. For a number of years a small breeding colony has occurred regularly near Hilger Landing on the upper Missouri River in Lewis and Clark County about 10 miles

east of Helena. I saw eight or ten of the birds on June 1, 1947, five of which were on their nests located in the upper crotches of a group of partially submerged cottonwood snags.

Aix sponsa. Wood Duck. Saunders lists but six records for the state, of which only two were from west of the continental divide. While never present in large numbers, I have found this species to be a regular summer resident near Missoula, Missoula County, and at Stevensville, Hamilton and Darby in Ravalli County. I have noted it every summer from 1942 to the present date and have seen downy young accompanying a parent on several occasions within two miles of the center of Missoula.

Aythya americana. Redhead Duck. Weydemeyer (Auk, 50, 1933:210) found this duck nesting near Fortine in Lincoln County. The species is one of the common breeding ducks at Ninepipe Reservoir, within and adjacent to the migratory bird refuge in Lake County.

Aythya collaris. Ring-necked Duck. Saunders gives no records for west of the continental divide. I saw a drake at Frenchtown, Missoula County, on September 21, 1941, one drake and two ducks eleven miles west of Missoula on May 8, 1948, and several individuals of both sexes between Perma and Paradise, Sanders County, on December 20, 1948.

Cathartes aura. Turkey Vulture. Mewaldt mentions (Condor, 52, 1950:238) three occurrences in Missoula County which would indicate that the bird is uncommon here. This conforms with my own experience in the first seven or eight years of my observations in this vicinity. In the summer of 1947 I discovered a roost in an inaccessible portion of a cottonwood swamp about two and a half miles west of Missoula. It has been occupied every summer since that date and it is not at all uncommon to see from twenty to thirty vultures there at one time, in the late summer and early fall. The earliest arrivals usually appear in the first week in April (earliest, March 27; latest, April 24) and their numbers are augmented until they reach their maximum abundance by early September. The last individual is usually gone before the first of October.

Falco columbarius. Pigeon Hawk. Saunders regarded this species as a rare summer resident in Montana and listed no winter records. Weydemeyer (Condor, 35, 1933:121) reports one seen on January 15, 1931, in Lincoln County. An individual appeared in Missoula on October 25, 1938, and was seen frequently until December 6, and since 1942, one or more of this species has spent all or part of the winter here regularly. Dates of occurrence are as follows: October 21, 1942, to January 24, 1943; December 6, 1943, to March 5, 1944; October 1, 1944, to February 11, 1945; October 2, 1945, to March 3, 1946; October 18 to December 31, 1946; September 13, 1947, to April 10, 1948; September 19, 1948, to February 15, 1949; September 18, 1949, to February 19, 1950 (at least 2 present); September 20, 1950, to March 3, 1951 (at least 3 present); and November 10, 1951, to date, December 3. Although these hawks may arrive quite early in the fall, the extent to which they linger in the vicinity seems to be closely coordinated with the appearance of Bohemian Waxwings in large flocks.

Catoptrophorus semipalmatus. Willet. Saunders gives no records from west of the continental divide. On September 2, 1951, I saw two of these birds on a gravel bar along the Clark Fork River about two miles west of Missoula.

Limnodromus scolopaceus. Dowitcher. Saunders lists no records from west of the continental divide. Weydemeyer (Condor, 33, 1931:128) has noted the species in Lincoln County in fall, but there appear to be no spring records. I saw three individuals at close range on May 8, 1948, about eleven miles west of Missoula.

Recurvirostra americana. American Avocet. Saunders records this species as a summer resident in suitable localities, mainly along the northern border of the state and as a migrant elsewhere. I have numerous records of this conspicuous species from many parts of western Montana. In 1947 and 1948 flocks of 50 or more were seen within a few miles of Missoula in late April and early May. Others have been noted in Granite, Deerlodge, and Ravalli counties, and the species appears to be a common summer resident at the Federal Migratory Bird Refuge at Ninepipe Reservoir in Lake County.

Archilochus alexandri. Black-chinned Hummingbird. Saunders considered this bird a rare summer resident of extreme northwestern Montana and listed no breeding records. It is not uncommon in the vicinity of Missoula. Nests with fledglings were noted within the city limits on July 19, 1942, and on June 27, 1947.

Asyndesmus lewis. Lewis Woodpecker. Apparently there are no previous winter records. During the winter of 1947 to 1948 a pair remained at Missoula until Christmas day and a single individual was seen again on January 11.

Cyanocephalus cyanocephalus. Piñon Jay. The only records from west of the continental divide are those reported by Weydemeyer (Condor, 29, 1927:159) from Lincoln County, a single individual seen on November 14, 1926, at Missoula by Caroline Wells (Condor, 30, 1928:322), and two specimens collected by Truman Smith from a flock of 100 or more on January 27, 1945, in Gird's Creek, east of Hamilton, Ravalli County (Condor, 47, 1945:129). The last record, reported by Philip L. Wright, may indicate a general influx of this species into western Montana during that particular winter in view of the following: On January 9, 1945, a scattered flock of between 30 and 40 individuals was watched for some time in Greenough Park, Missoula. The birds were tame and easy to approach. On May 3 of the same year, Mr. K. D. Swan of Missoula saw a similar sized flock at Bandmann Flats, a few miles east of Missoula.

Regulus calendula. Ruby-crowned Kinglet. There is no previous winter record. These kinglets normally arrive at Missoula in the first half of April and leave in mid-October. One was seen on December 11, 1938, after more than a month of severe winter weather.

Bombycilla cedrorum. Cedar Waxwing. There are no previous winter records for the state. This species has been a regular winter resident in Missoula since 1943, with few exceptions. In 1950–51 larger flocks than usual, up to 75, remained until mid-December; thereafter only a few were noted until February 12 after which they all disappeared. In this locality the Cedar Waxwings appear in their greatest abundance immediately following the breeding season and it is not unusual to note flocks of one to two hundred during September and October. When the Bohemian Waxwings arrive (usually between October 20 and November 15), the first few of the advance guard of that species commonly attach themselves to flocks of resident Cedar Waxwings that are prevalent at that time. If one watches these mixed flocks continuously, he will note a gradual reversal in the ratio between the two species. By the end of November the Bohemians may be present in flocks aggregating a thousand or more individuals while it becomes a matter of extreme patience and perseverance to note with certainty that a few Cedars may be among them. Later in the winter the two species seem more inclined to separate, the Cedars in small detachments by themselves or associated with Robins and Evening Grosbeaks.

Euphagus carolinus. Rusty Blackbird. Recorded by Saunders as a rare migrant in eastern Montana, with no records except from Custer County. Weydemeyer (Condor, 38, 1936:87) records it in fall from Lincoln County. I saw a single individual in the characteristic rusty fall plumage on September 17, 1950, in the Orchard Homes residential section of Missoula.

Carpodacus cassinii. There is no previous winter record for the state. The species normally arrives at Missoula during the first half of April (earliest, March 30) and departs in September (latest, October 13). I saw a male on December 20, 1946 (temperature 1 below zero), three females on December 8, 1948, and a flock of about 30 on February 20, 1949.

Zonotrichia querula. Harris Sparrow. The only record from west of the continental divide is reported by Weydemeyer from Lincoln County (Condor, 39, 1937:129). I saw one in Greenough Park, Missoula, on October 13 and 14, 1950. It appeared to be immature.

Zonotrichia albicollis. White-throated Sparrow. Weydemeyer (Condor, 29, 1927:159) lists a number of sight records for Lincoln County; otherwise there appears to be none from west of the continental divide. I have seen typical adults in the vicinity of Missoula on the following dates: October 11, 1938 (2), October 14, 1944, (1) and October 18, 1946 (1).

Melospiza georgiana. Swamp Sparrow. Saunders lists two records from west of the continental divide, one from Silverbow County, the other (recorded as doubtful) from Flathead Lake. I saw two at the edge of a slough along the Clark Fork River two miles west of Missoula on October 17, 1948, and again on November 7 of the same year.—R. L. Hand, *United States Forest Service, Missoula, Montana, January 1, 1952*.

NOTES AND NEWS

Nelson K. Carpenter, member of the Cooper Ornithological Society since 1901.

The editors of The Condor have had the benefit of counsel from the Editorial Advisory Committee in the past two years which has helped substantially in the program of publication. When this committee was set up in 1951, a rotating participation in it was envisioned. Two new members take part this year, namely John T. Emlen, Jr., and Ian McT. Cowan. To the continuing members and to those participating in the past the staff expresses its appreciation of important aid given.

Beginning with this issue of The Condor, the supplementary title of the journal takes account of the change of the name of our organization to Cooper Ornithological Society. When this change was duly voted at the business meeting in May, 1952, a large majority of those present or sending in proxies favored the change. In calling for votes by proxy no arguments were presented for the change, because it was desired that the vote be registered without pressure from the boards of governors and directors who had studied the matter. Once the decision had been reached it became evident that many in the organization although agreeable to the change did not fully know the reasons for it that had been considered by the board of governors. The basic reason was to avoid misunderstanding about the nature of the organization. In academic, scientific and fiscal circles a club is frequently regarded as a social or non-scientific group primarily; explanations had to be made to various institutions that our group was a scientific society, eligible for tax-free status, and without political or social objectives. The organization many years ago outgrew the period when it was a local club of young men who collected birds and birds' eggs. It became a scientific society in the correct sense of the word and published a journal of national and international interest. A correct designation adopted with no thought of altering the informal and friendly spirit of the organization seemed preferable to the preservation of an outmoded name merely for the sake of tradition.—A. H. M.

The painting of the Collared Micrastur (*Micrastur semitorquatus*) reproduced in this issue is the twentieth painting by Andrew Jackson Grayson to appear in the Condor. Grayson painted this hawk at Mazatlán, México, from a specimen collected there in 1864. This species inhabits dense lowland forests of the American tropics. It is shown with a thrush, probably *Turdus rufopalliatus*, which it had recently captured.

We learn with regret of the death of Clark P. Streator on November 28, 1952, in Santa Cruz. Mr. Streator, who was a pioneer collector in the west since the 1880's, had recently been elected an honorary member of the Society.

Cost of publishing extensive tabular material in connection with the paper by Dr. Oakeson has been met by special subsidy.

MORE TROUBLE FOR THE CALIFORNIA CONDOR

On November 24, 1952, the California Fish and Game Commission granted a special permit to the San Diego Zoo to capture a pair of California Condors. This was done despite the vigorous objections of C. V. Duff and the undersigned, and of Milton Hildebrand representing the Sierra Club. John H. Baker of the National Audubon Society also protested but his statement was not available in time for the Commission's meeting, as the action was taken on rather short notice. Granting of the permit was recommended by the Bureau of Game Conservation.

It was contended by those objecting that the extensive research report now in press by Carl

B. Koford fully demonstrates the precarious position of the California Condor and shows that any tampering with the small surviving population is dangerous. Facts derived from Koford's report were presented in the form of letters; indeed the whole report could have been consulted at the library of the University of California had the wildlife technicians of the Bureau of Game Conservation cared to do so. It is curious that the Bureau, which purports to put much stock in research as a basis for managing wildlife, should in this instance deliberately ignore a well documented study, relying instead on casual observation and opinions to the affect that there are plenty of condors and that removing a few would do no harm.

The natural desires of zoological gardens for examples of rare species are perfectly understandable human and organizational aspirations, but at times these must be countermanded when a species is in really precarious state and when it can not possibly be aided as a natural living entity by the keeping or even the breeding of captives. It is a dubious honor to a zoo should the last of a species ultimately die on its hands. But the most disheartening aspect of this whole matter is that the administrative and law-enforcing body charged with conservation in the state of California has chosen, legally to be sure, but without recourse to the most thorough research and the full study of it, to take an action that might prove to prejudice the perpetuation of the California Condor. This is not the place to present a full review of Koford's findings, for his monograph will soon be available as Research Report No. 4 of the National Audubon Society. From it conservationists may judge of the wisdom of this action of the California Fish and Game Commission.—Alden H. Miller.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

MAY.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held on May 27, 1952, at the University of Southern California. The following names were proposed for membership: William F. Clements, 510 S. Spring St., Los Angeles 13, Calif., by Robert T. Moore; John D. Cunningham, 1311 5th St., Santa Monica, Calif., by Francis H. Boynton; M. Christine Davenport, 817 Terraine Ave., Long Beach, Calif., by Ross Hardy; Eileen Louise Mair, International House, Room Y-40, Berkeley 4, Calif., by C. V. Duff; Ollie Daytona Brown, 8964 Wonderland Ave., Los Angeles 46, Calif., and Albert E. Hildinger, 1801 Lucile Ave., Los Angeles 26, Calif., by Jack C. von Bloeker, Jr.

J. R. Pemberton spoke on his recent trip to Africa, and showed colored slides.—DOROTHY E. GRONER, *Secretary*.

SEPTEMBER.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held on September 30, 1952, at the University of Southern California. The following names were proposed for membership: Edward L. Hansen, 1087 "H" St., Arcata, Calif., by Mrs. J. Q. Burch; F. Herrick Herrick, 7816 Amestoy Ave., Van Nuys, Calif., by Ed Harrison; Harry McClure Johnson, Zoology Dept., Cornell University, Ithaca, N.Y., by K. E. Stager; Frank Juskiewicz, 726½ Simpson, Ft. Morgan, Colo., and Miss Marjorie McGranahan, Box 838, Folsom, Calif., by F. H. Boynton; Gordon E. Lund, 839 4th St., Prince Albert, Sask., by W. J. Sheffler; Ralph E. Ramey, Jr., 1140 W. Ashby Pl., San Antonio, Texas, and Arthur R. Thompson, 879¼ Lookout Dr., Los Angeles 12, Calif., by J. C. von Bloeker, Jr.; Roy Garland Robinson, Jr., 925¾ W. 36 Pl., Los Angeles 7, Calif., and O. C. Willis, 243 W. 71st St., Los Angeles 3, Calif., by Wade Fox, Jr.; Robert Winter, 4671 Harvey Ave., Fresno, Calif., by Henry Childs; Lt. William H. Adams, R.F.D. 2, Box 246, Selma, Alabama, Newell Charde, 1518 E. Wilson, Glendale 6, Calif., Raymond J. Fleetwood, 324 N. 6th St., Socorro, New Mexico, Dr. Jack Lewis Gazzola, 1302 5th Ave., San Rafael, Calif., William Harold Kaeane, 127 Ruby St., Winnipeg, Manitoba, Muriel Kaminsky, 1213 Robertson Way, Sacramento 18, Calif., P. W. Louwman, % Dierenpark "Wassenaar," Wassenaar near The Hague, Holland, William B. Murphy, 522 Hillgreen Dr., Beverly Hills, Calif., F. L. R. Roberts, M.D., 925 Wakefield, Corona, Calif., Dr. Oliver K. Scott, 437 E. 13th St., Casper, Wyo., G. Donald Sparkman, Jr., Hill Farm, Coatesville, Penn., Dr. Benj. Svoboda, 1711 N. Dillon, Los Angeles 26, Calif., Mrs. O. H. Wallin, 11543 36th N.E., Seattle 55, Wash., John Overby Watkins, M.D., 359 Pine St., Spartanburg, N.C., John H. Wentz, 5628½ Carlton Way, Hollywood 28, Calif. Ynez Yna Whilton, 10390 Ashton Ave., Los Angeles 24, Calvin Wilson, 589 E. 13th South, Salt Lake City, Utah, and William Andrus Wooten, P.O. Box 407, P.O. Bldg., Eureka, Calif., by C. V. Duff.

Dr. William R. Fish, speaker of the evening, illustrated his work in analyzing and recording bird song.—DOROTHY E. GRONER, *Secretary*.

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January 1, 1953

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